ENGINEERING NEWS

THE latest rapid transit scheme in this city is for an underground road from the City Hall to the Forty-second Street depot, *via* Elm street and Fourth avenue. It is to be a four-track road; the center lines for express trains to make the distance in 7 minutes, and the outer lines for local traffic. The New York *Times* names W. K. VANDERBILT, CORNELIUS VANDERBILT, CHAUNCEY M. DEPEW, O. B. POTTER, JOHN JACOB and WM. W. ASTOR, the RHINELANDERS, LORILLARDS and others of like ilk among the promoters. If there is any foundation for the use of these names, money at least should not be lacking. The plan includes the widening of Elm St. and its extension to a junction with Fourth avenue near Astor Place. The chief advantage claimed over the Broadway project is the little or no opposition from contiguous property owners. There would be stations every four or five blocks for local trains, and double that distance for express trains; each station to be 400 ft. long. Underneath the tracks would be separate apartments for steam, water and gas pipes, electric wires and sewers; with special openings at intervals for access to these appliances. The whole route is to be lighted by electricity, and the motive power would either be electricity preferably, or fireless steam engines. The tunnel would be of brick, and the estimated cost is $2,000,000 per mile. The scheme, while it is confined for the present to the route indicated, contemplates an extension to Maiden lane, if the proposed new street between Nassau and William streets is opened to that point. Any extension further north than Forty-second streets will be deferred until the first section is in operation. The promoters are proceeding under the general laws of the State, and it is said they have already secured the consent of seven-eighths of the property owners along the route, instead of the necessary two-thirds only. The enterprise now depends solely upon the adoption of the plans by the Common Council and the Board of Street Opening and Improvement for the widening and extension of Elm street.

SINCE writing the above it turns out that the Elm St. tunnel project has greater dimensions than were at first anticipated. Word now comes that an extension is proposed from the City Hall terminus of the first section to be built, under Park Row and Broadway to St. Paul's churchyard, gradually descending to a point in West St. near the foot of Rector and thence under the Hudson river to a connection with the Penna. R. R., near the mouth of the Morris canal in New Jersey. Engineers claim to have found on this line a continuous ridge of solid rock traversing the river "without break or fissure," and "which can be easily and cheaply tunneled." Other branch tunnels would run to the 34 St. Ferry on the East river and to the 23 St. Ferry on the North river. The same report says over $30,000,000 of the stock of this enterprise has already been subscribed for.

THE New York Arcade Railway is said "to have now made a fair start;" which statement seems to be correct if an approval of its estimates for construction by Messrs. O'BRIEN & CLARK, contractors on the New Croton Aqueduct, can be considered "a start." The main line runs through Broadway to 59th street and Eighth avenue, with a branch from Madison Square out Madison avenue to the 42nd street depot. It would be a four-track road with two center express tracks. The engineer's estimate below 59th street is $1,800,000 per mile, with $1,200,000 additional for stations, terminals, rolling-stock, etc., or altogether $3,000,000 per mile. The total estimate from the Battery to 59th street is $30,000,000, with as much more to carry the line 8 miles further to Kings Bridge. With money and material provided the engineers think that two years will suffice for the construction of the first section to 59th street. In published interviews with Gen. NEWTON and Chief Engineer CHURCH, of the New Croton Aqueduct, both of these gentlemen are made to heartily endorse the arcade project. Gen. NEWTON very properly calls attention to the fact that no arcade railway plan should be considered without at the same time caring for the entire underground furniture of the street and the permanent paving of the roadway. This supplementary work should be done by the city at a cost of from $300,000 to $500,000 per mile, and the proper apportionment of the cost of this work should be carefully fixed beforehand.

As intimated in a previous issue, the contractors for the erection of the Poughkeepsie bridge are now drawing the 130 ft. spliced piles used under the falseworks of the west connecting span. These piles were driven from 50 to 60 ft. into the mud bed of the river and depending upon friction alone had supported without any settlement the weight of the timber work and 525 ft. iron span. In drawing these piles they have first to be started by from 10 to 20 blows of a 6,000 lb. hammer falling 20 ft. After they have been driven from 1 to 2 ft., and the mud bond broken, two falls are attached to the pile about low water mark, or 10 to 12 ft. below the pile head; one of these falls is attached to the lower chord of the bridge and the other to the head of the pile-driver, and they are thus drawn. The piles are finally handled by the pile-driver alone, and the greatest breakage of the piles occurs at this point, about 1 in 10 being broken owing to their slight lateral strength when lifted. The sound piles will again be used under the east connecting span next spring.

THE New York Central & Hudson River Railroad has followed the lead of the Pennsylvania by inaugurating steam-heated vestibule-car service for its limited New York-Chicago trains and this week gave a complimentary trip to Albany and back to railroad and newspaper men to inaugurate the service. The cars are all new, and the train consists of a luxurious parlor smoking car with bath-room, barber shop, writing desks, buffet, books and periodicals, with a baggage compartment in the forward end, a handsome dining car, two sleepers and two parlor cars. The cars are of enormous length, some 75 ft., 53 ft., between truck centers; so long as to scrape some of the tunnels slightly. The steam heat is by the Wilder system, which we have already described, and made an unexceptionable showing. The weather was not such as to test it severely, but there was no chance for doubt that it was adequate for all requirements. The New York Central has also many trains equipped by the Martin system, and like the Pennsylvania is pushing the introduction of steam heat fast. The invitations for the trip came from President CHAUNCEY M. DEPEW, who has apparently received a flood of light as to steam heating possibilities since he delivered the valuable engineering judgment that it was impossible, after the White River disaster, which we had occasion to comment on last winter.

In all, on the New York Central, radiators have been placed in about 80 passenger coaches, and 22 local trains are using steam heat.

THE first annual report of the Inter-State Commerce Commission shows a splendid record, fully justifying the view taken by this journal from the first, that the law as a whole was well drawn and would work well, and showing up the affected apprehensions of would-be organs in a rather amusing light. As might be expected with a power behind that was really able to control, the *spirit* of the law has been lived up to very generally, without waiting for the slow process of judgment in each possible case, which was so forcibly argued was impossible by long arrays of figures. No one has been ruined but many companies have been benefited greatly, and many undoubted abuses have died a silent and unnoticed death. The chances are now very strong that the scope of the Commission will be gradually enlarged, especially as respects gathering statistical information, while the opposition to the work they are doing has now almost disappeared.

IT is reported that the International Dock & Warehouse Co., an Anglo-American syndicate, including the Furness Railway Co. of England, and the Minn. & Northwestern R. R. Co. in its management, will begin next spring to construct a system of docks and warehouses near Clifton, on Staten Island. The estimated expense is $1,500,000, and the docks will extend to deep water in the Narrows. This arrangement is said to include an interest in the Staten Island Rapid Transit R. R. and the Kill von Kull bridge, both of these being of late controlled by the Baltimore & Ohio R. R. Co.

THE Pittsburg Steel Casting Co. received on Dec. 2 the U. S. contract and a wooden model of the gun it is to make for the Government. This gun is to be cast in one mass, and will be 16 ft. 1 in. long and 22½ in. in diameter at the breech outside. The press accounts do not give the finished bore, but it is to be rough-bored and then rifled, and will be a breech-loader. We are glad to see that this experiment is at last to be made, and trust that the Pittsburg makers will renew, in their cast-steel rifled guns, the triumph of the past in Rodman guns of cast-iron. The two weapons are unlike in their service, but the better material and the advanced knowledge in its manipulation, should produce correspondingly successful results.

RAILROAD SHOP statements of cost of work have always been open to more or less suspicion. The following is a curious illustration that there is reason for it: A statement of the cost of building locomotives in the shops of the Canadian Pacific Railway Co. indicates that such work is done a good deal cheaper in Canada than in this country. The mechanical superintendent of the Canadian Pacific, states the cost of building an 8-wheel road engine, American type, cylinders 17×24, drivers 62-in., weight of engine in working order, 87,000 lbs., is at $5,740, 10 per cent. being added to both material and labor. On the other hand, the superintendent of machinery of one of the principal Chicago roads furnishes the following figures as the result of his experience in recent locomotive building: A 50-ton Mogul engine cost, with 10 per cent. added, $8,967; four 8-wheel passenger engines, cylinders, 17×24, drivers 5 ft. in diameter, weighing 42 tons, cost $7,420 each; 10 Mogul freight engines, cylinders 18×24, drivers 4 ft. 8 ins., weighing 47 tons, cost $7,349 each. Here is a remarkable difference in cost on paper; it can hardly be so in fact.

THE following bridge accidents are reported: On Nov. 28, a freight train on the St. Louis, Arkansas & Texas Railroad went through the Dorcheat bridge about 40 miles east of Texarkana, Ark. Two men were injured.——On Nov. 29, the Mud lake trestle on the St. Paul & Duluth Railroad, 2 miles south of Spirit lake, gave way under a freight train; 16 cars were wrecked.——On Dec. 2, the timbers of a bridge near Whitewright, Tex., on the St. Louis, Arkansas & Texas Railroad were nearly all washed away and the structure collapsed under a passenger train. No one was injured.

THE most serious railroad accident of the week was a head collision Dec. 3 between an engine and a freight train on the Louisville & Nashville Railroad, between Mitchellville, Tenn., and Franklin, Ky. One man was killed and two severly injured.——A freight train on the Lake Erie division of the Baltimore & Ohio Railroad was derailed and thrown down a 25 ft. bank near Independence, O., Dec. 3. One man was killed and another fatally injured.——The north bound Montreal express on the Delaware & Hudson Canal Company's Railroad was wrecked Dec. 7 at Whallonsburg station, Dec. 7, by a broken axle or wheel under the tender. Three cars and the station were destroyed by fire originating from the car stoves. No one was injured, however, making it but a small beginning of what will undoubtedly be a longer and blacker list before the winter is over.

TWO explosions of locomotive boilers are reported. On Dec. 2. the boiler of the engine of a Philadelphia & Reading Railroad coal train exploded near Tamaqua, Pa., killing 5 men.——On Dec. 5 the boiler of locomotive No. 170, Intercolonial Railroad, exploded while standing at Stellarton station, N. S., killing 3 men and seriously injuring 2 more.

THE report of the Kansas State Board of Railway Commissioners shows the total earnings of all the railway lines in that State for the year ending June 30, 1887, to be $72,600,111; the expenses for the same time were $69,779,677. The total capital stock was $306,333,290; and the bonded indebtedness, $360,738,639.

A New Bridge Truss.

BY GEORGE H. PEGRAM, M. AM. SOC. C. E.

(*With Inset.*)

INTRODUCTION.—In the present advanced stage of bridge building, and with the many able minds constantly employed in the investigation and development of the art, a new form of truss would naturally invite attention, and claims for its superiority over existing forms would justly be subjected to criticism. Especially would this be the case where, after 40 years of competition with all manner of forms, the Whipple truss still holds its place as the most economical. So persistently has it held this place that some have even doubted the possibility of surpassing it.

MR. CHARLES B. BENDER, in his "*Principles of Economy in the Design of Metallic Bridges*," after making comparisons with the different forms of trusses, thus concludes:

"None of these forms is of pronounced practical value. It is, however, good that they were once thoroughly examined, and that we now know that greater economy than is offered by the Whipple truss can hardly be obtained."

The subject will be treated in a purely practical manner, keeping constantly in mind the actual operations in the design and construction of a bridge.

PRIMITIVE FORMS OF THE TRUSS.—Abroad, curved chord trusses are generally used; here they are but rarely used. The main reason for this is, that their known economy in weight is absorbed by the increased cost of the shop work entailed by having a great variety of lengths and sizes.

The object in the new truss is to exceed the theoretical economy of the European forms, and at the same time adapt the work to the more general use of machinery. Incidentally, a number of other advantages are gained which will be noticed in the sequel.

In the primitive form of the truss the panels of the tensile chord are of equal lengths; the panels of the compressive chord are of equal lengths, but shorter than those of the tensile chord; and the posts are of equal lengths. The truss is formed in the following manner:—On any assumed chord line the lengths of panels which it is desired to have, are laid off. From these panel points as centers, arcs are described with the post length as a radius. When the number of panels is even, the middle post will be vertical; when odd, the posts bounding the middle panel will have inclinations dependent upon the ratio of the panel lengths of the two chords, in practical cases being but slightly inclined. From the end of the middle post, arcs are described, with a desired panel length as a radius, intersecting the arcs previously described; and from these intersections, as centers, and the same panel length as a radius, arcs are described to find the next panel points, etc. Thus, referring to Fig. 2, Plate, I, the straight bottom chord is divided into eight equal panels. A length p is assumed for the posts, with which, as a radius, arcs are described from each of the panel points. From the top of the vertical middle posts, with a chosen top chord panel, arcs are described as in the figure, and the form of the top chord thus determined. If the assumed chord line is straight, the other chord will be a curve which, for through bridges, agrees closely with a circle up to the post whose inclination to the vertical does not exceed 30°. Beyond this point the curvature increases more rapidly. The inclination of the posts gradually increases from the middle to the ends of the truss.

It is generally desirable in bridges with double intersection bracing, though not important, to have the top of the end-post vertically over the first panel point as in Fig. 1. In drawing the figure of the truss this may be attained by a series of trials involving very little trouble.

A variety of proportions and forms would be used depending upon the requirements of the case, thus on Plate 1, Fig. 1, represents a through bridge, with a double system of bracing; Fig. 2, a through bridge, with a single system of bracing; Fig. 3, a deck bridge; Fig. 4, a highway bridge where extra clearance under the middle of the bridge is desired. It is also adapted to large roofs; Fig. 5, a pivot bridge; Fig. 7, a deck highway bridge, and Fig. 8, a cantilever. Fig. 12 is a proposed truss for a 650-ft. span, with 24 panels of 27 ft. 1 in.; posts 75 ft. long, and having a quadruple system of bracing in the end portions. In Figs. 4 and 7, the top chord is a circular arc, the bottom chord being constructed with the equal posts and chord panels.

For all purposes, except the actual manufacture, the lengths of the diagonals may be obtained with sufficient accuracy by scaling the figure. When, however, the bridge is to be built, the exact lengths must be calculated by first finding the coördinates of the constructed chord. To do this, we must start at the middle of the truss as in the construction of the figure. If the number of panels is even, the middle post will be vertical; if odd, the horizontal projections of the posts bounding the middle panel will be half the difference between the chosen lengths of top and bottom chord panels. In any case, therefore, the horizontal and vertical projections of the middle posts are known. In Figs. 2 (through bridge) and 3 (deck bridge), Plate 1, let x and y be, respectively, the horizontal and vertical projections of any post; let h and v be the corresponding projections of the post *next nearest the middle of the truss*; let a be the length of a panel; q, the assumed chord; p, q, the constructed chord, and p, the length of the post whose projections are to be found; further let t be the distance from the panel point of this post in the assumed chord to a vertical line through the outer end of the next post nearest the middle, so that for *through* bridges (Fig. 2) $t = a + h$, and for deck bridges (Fig. 3) $t = a - h$, we then have

$$x^2 + y^2 = p^2, \text{ whence } x = \sqrt{p^2 - y^2} \qquad (1)$$

and $(t \mp x)^2 + (v - y)^2 = b^2$; the minus sign in the first term applying to Fig. 2 and the plus sign, to Fig. 3, solving these equations and reducing to a convenient form we have (2) $y =$

$$\frac{1}{2}\left(1 + \frac{p^2 - b^2}{v^2 + t^2}\right)\left\{v + t\sqrt{\frac{4p^2}{(1 + \frac{p^2 - b^2}{v^2 + t^2})(v^2 + t^2 + p^2 + b^2)} - 1}\right\}$$

This formula applies to both through and deck bridges having one straight chord. It is perfectly general as regards a, b and p, which may vary with every panel. Ordinarily, they will be constant for one truss and $(p^2 - b^2)$ and $4p^2$ will require to be determined but once. As each value depends upon the one previously found, it would be well in applying the formula, to check each point before proceeding with the next. It is generally desired to have the curved chord end at definite points. In deck spans these would of course be on the piers and their distance apart would be the span. In through bridges with double web bracing they would be vertically over the first panel points of the bottom chord, and their distance apart would be two panels less than the span. In through bridges with single web bracing, which would include spans under 160 ft., the best results will be obtained by making the projection of the end-post equal to three-quarters of the bottom chord panel so that the distance apart of the ends of the curve would be one and a half panels less than the span. In order to insure these conditions, the panel length of the constructed chord should be determined by means of the following empirical formula, in which l = the half length of the curved chord, k = the half span of the curved chord, m = the middle ordinate or rise of the curve.

$$l = k + \left(6 + \frac{15\,m}{100}\right)\frac{m^2}{10\,k} \qquad (3)$$

The length l, divided by the number of panels will give the required panel length with practical exactness.

BARLOW'S Tables of squares, etc., are of great assistance in the use of these formulas.

Examples of the application of formulas (1) (2) *and* (3).

Through span 255 ft. (see Plate 2) in 12 panels of 21.25 ft. Posts 35 ft. throughout. Curved chord to end vertically over end panel points of bottom chord.

$$m = 35 - \sqrt{(35^2 - 21.25^2)} = 7.189 \text{ ft.}$$

$$k = 5 \times 21.25 = 106.25.$$

substituting values in (3) we have $l = 106.594$ and dividing by the number of panels we have 17.766 ft., the length to be taken for the top chord panels, or the value of b in formula (2).

P_0 by formula (2)

$p^2 = 35^2 = 1225.$ $v^2 = 35^2 = 1225.$

$c^2 = 17.766^2 = 315.63076$ $l^2 = 21.25^2 = 451.5625$

$p^2 - c^2 = 909.36924$ $v^2 + l^2 = 1676.5625$

$909.36924 \div 1676.5625 = 0.54240$

$(909.36924 + 1676.5625) \times 1.54240 = 3988.541$

$(4p^2 = 4900) \div 3988.541 = 1.22852$

$(\sqrt{1.22852 - 1} = .47804) \times 21.25 = 10.15835$

$$(10.15835 + (v = 35)) \times \frac{1.54240}{2} = 34.82612 = y$$

by formula (1) $x = \sqrt{(35^2 - 34.82612^2)} = 3.48444$

P_8—

*$t = 21.25 + 3.48444 = 24.73444$ $t^2 = 611.79252$

$v = y$ of $P^6 = 34.82612$ $v^2 = 1212.85865$

$v^2 + t^2 = 1824.65117$

$909.36924 \div 1824.65117 = .49838$

$(909.36924 + 1824.65117) \times 1.49838 = 4096.6015$

$4900 \div 4096.6015 = 1.19611$

$(\sqrt{.19611} = .44285) \times 24.73444 = 10.95365$

$$(10.95365 + 34.82612) \times \frac{1.49838}{2} = 34.29775 = y$$

$x = \sqrt{(35^2 - 34.29775^2)} = 6.97598$

In this way the projections of the posts are found to be

	P_1	P_2	P_3	P_4	P_5	P_6	P_7
x	21.246†	17.593	14.016	10.483	6.976	3.484	0.000
y	27.813	30.257	32.071	33.303	34.298	34.826	35.000

The end panels of the top chord are necessarily so different from the intermediate panels that there is no advantage in preserving the same length. The end posts are so entirely different from the intermediate posts that there is no reason for making these of the same length; and, further, the intermediate posts may be of two or more classes, say of 10-in. and 12-in. channels, which classes might be of different lengths.

The curvature of the chord may, therefore, be increased when desired by making the top of the post *next* to the end come vertically over the *second* panel point, keeping the end post as before vertically over the first panel point, but changing the lengths of the end-post and end top chord panel to accomplish this; and it may be still further increased by making the end class of intermediate posts shorter than the middle class.

MODIFIED FORMS.—The merits of the truss will be considered later on, but it is necessary to here touch upon a few points affected by the form.

Equal lengths of posts and chord panels, respectively, are obvious advantages in the shops. The curvature of the chord when formed of eyebars, as in deck bridges, is no disadvantage; but in through bridges where the chord is made of built sections it is, though to a very small extent, a disadvantage. To reduce this to a minimum and also sometimes for other considerations, it is often desirable to use modified forms.

The change of direction of the chord at each panel point is *so small* that it is of no importance whether the joint occurs at the pin or to one side of it, or whether the level is equally divided between the abutting faces, or one is milled square and all of the bevel put in the other; so no changes from the present styles of constructing these joints need be made. It would obviously be better to have the curvature of a built chord uniform, so that the change of direction would be the same at all of the joints. In this case the panel points would lie in the arc of a circle with equal length panels, the posts would then be of different lengths, but by a proper choice of curvature these may be made practically equal.

The radii which will insure the best results in this respect *i. e.* the least difference in the lengths of posts of the same class, rarely greater than 1 in., are obtained by the following formulas, in which a = the length of panel of the assumed chord n, = half the number of panels in the curved chord p, = the height of truss at the middle (about the desired length of posts) r = the radius of curvature. For *through* and *deck* spans with *single web bracing*.

$$r = \frac{\left(\frac{a}{2}\right)^2[2(n - \frac{1}{2})^2 - \frac{1}{2}]}{p - \sqrt{p^2 - \left(\frac{a}{2}\right)^2}} + p \qquad (4)$$

*In *deck* spans l would be the *difference* instead of the *sum*, as previously explained.

†For the top of the end-post to be *exactly* vertically over the first panel point this should, of course, be 21.25, the difference (.004') is inappreciable, and as it is simply a question of appearance a difference of ten times this amount would not be objectionable.

As previously stated the horizontal projection of the curved chord in *through* bridges with *single web bracing* should be less than the length of the assumed chord by one and one half panels, that is to say, the end-posts should project over three-fourths of the end panel.

For bridges with *double web bracing*

$$r = \frac{n \mp 2}{2} \cdot \frac{[a\,(n-1)\,]^2}{n\,p - \sqrt{n^2\,p^2 - [a\,(n-1)\,]^2}} + p \quad (5)$$

the *minus* sign of the coefficient applying to *through* spans, and the *plus* sign, to deck spans.

In these spans, as also previously stated, the horizontal projection of the curved chord in through spans should be less than the assumed chord by two panels *i. e.* the horizontal projection of the end-post should be equal to the panel length of the assumed chord.

In cases where it is desired to give the chord a *greater curvature* than would be possible with equal posts, the circle would also, of course, be used and the following relations will sometimes be found useful viz:—

$$r = \frac{c^2 + d^2}{2\,d} \quad (6)$$

$$d = r - \sqrt{r^2 - c^2} \quad (7)$$

and approximately, but sufficiently exact

$$l = c + \frac{2d^2}{3c} \quad (8)$$

in which c = the half chord of a circular arc, l = the half length of a circular arc, d = the middle ordinate, or rise, r = the radius.

In curved chord trusses c will always be known, and either d or r, according to circumstances.

Since in a circle equal chords subtend equal angles at the center, the determination of the coördinates of the panel points of the curved chord becomes a very simple matter. See Fig. 9, Plate 1.

Let $= \theta$ the angle of the half arc, whence $\frac{\theta}{n}$ = the angle subtended by each panel. We then have, preserving the same notation as previously used,

$$sin.\ \theta = \frac{c}{r} \quad (9)$$

Further let N be the number of panels any panel point of the assumed chord is from the middle of the truss; then, the coördinates, or rather projections, of the post at that panel are

$$x = \pm\, N\,a \mp r\ sin.\ N\,\frac{\theta}{n} \quad (10)$$

$$y = r\ cos.\ N\,\frac{\theta}{n} - (r - p) \quad (11)$$

The upper signs (+ —) of formula (10) applying to *through* bridges, and the lower signs (— +) to *deck* bridges.

The term $(r - p)$ in formula (11) will be recognized as the value of the first terms of the expressions for the radii in formulas (4) and (5).

The lengths of the posts are of course obtained by

$$p_1 \sqrt{x^2 + y^2} \quad (12)$$

Tables of logarithms similar to BRUHN'S greatly facilitate calculations by formulas (9), (10) and (11) and BARLOW'S tables, formula (12).

Examples of the application of the formulas for circular arc chords.

Example I: required, the lengths of the posts in a 255 ft. through span, similar to that shown on Plate 2, but with a circular arc chord, $p = 35$, $a = 21.25$, $n = 6$. By formula (5),

$r = 783 + 35 = 818.$
$c = 21.25 \times 5 = 106.25$

log. c = 2.0263289
log. r = 2.9127533

log. *sin.* θ = 9.1136756

$\theta = 7°\ 27'\ 47.6''$

$\frac{\theta}{n} = 1°\ 14'\ 38''$

P_6

log r = 2.9127533
log. *sin.* 1° 14′ 38″ = 8.3360248
1.2487781
17.757

log. r = 2.9127533
log. *cos.* 1° 14′ 38″ = 9.9999976
2.9126509
817.807

$x = 21.25 - 17.757 = 3.493$ ft. $\quad y = 817.807 - 783. = 34.807$ ft.

$p_1 = \sqrt{x^2 + y^2} = 34.982$ ft.

In this way the projections and lengths of the posts in feet, are found to be as follows:

	P_1	P_2	P_3	P_4	P_5	P_6	P_7
x	21.249	17.630	14.054	10.511	6.994	3.493	0.000
y	28.049	30.185	31.918	33.265	34.229	34.807	35.000
p_1	35.189	34.957	34.875	34.897	34.936	34.982	35.000

Referring now to the strain sheet, Plate 2, we see that P_1 is the end post and not to be considered with the other posts. P_2, P_3 and P_4 are of 10 in. channels. The last two are of nearly identical lengths, and the first differs by less than an inch. The other posts are of 8 in. channels. The greatest difference in the lengths of these is .064 ft., or about three-quarters of an inch. The difference in lengths would be made in varying the position of the upper pin hole, the posts being alike in other respects.

Example II. 255 ft. *deck* span similar to that shown on Plate 3, but with circular arc chord.

$p = 35 \quad a = 21.25 \quad n = 5$
$r = 1147 + 35 = 1182$ ft. $\quad \theta = 6°\ 11'\ 32.8''$

	P_1	P_2	P_3	P_4	P_5	P_6
x	21.249	17.070	12.844	8.583	4.297	0.000
y	28.103	30.585	32.516	33.895	34.724	35.000
p_1	35.232	35.026	34.968	34.965	34.989	35.000

The extreme difference in the lengths of the intermediate posts is but three-quarters of an inch.

Example III. 120 ft. *through* span *single web bracing* (see Fig. 9, Plate 1). 6 panels of 20 ft.
$c = 45 \quad p = 25 \quad a = 20 \quad n = 3$. By formula (4)
$r = 192 + 25 = 217$ ft. $\quad \theta = 11°\ 58'\ 6.5''$

	P_1	P_2	P_3	P_4
x	15.000	9.878	4.913	0.000
y	20.283	22.899	24.474	25.000
p_1	25.227	24.939	24.962	25.000

The greatest difference in the lengths of the intermediate posts is seen to be three-quarters of an inch.

It will be observed that posts differ less in length in deck spans than in through.

Fig. 6, Plate 1, represents a truss with a circular arc bottom chord, and top chord of two straight lines. This would serve well for a highway bridge where extra clearance under the bridge is required, or for roofs with straight outsiders and vaulted ceiling below. With the exception of the middle post, the intermediate posts are nearly of equal lengths.

ECONOMY.—The economy in weight of the new truss arises from a closer accordance with theoretical principles and the economy in work, from the smaller number and sizes of parts and greater uniformity in members of the same kind.

The chords are far apart where there is the largest moment to resist and approach each other where the moment is small. The truss is deeper than parallel chord trusses at the middle and shallower at the ends. The sectional area of the chord is, therefore, made more uniform and the theoretical weight more nearly approximated. Besides this, the chord through its inclination relieves the web members of shearing strain, thus reducing the weight of these members. These advantages are gained in a degree, in the curved chord trusses of the forms now in use which are known to be the lightest. The advantages which the proposed forms have over these are: that the compression chord is made of short panels which gives it stiffness and allows of a higher unit stress while the tensile chord sections are made of the greatest practicable length, thus reducing the number of these tensile parts and also the work, as they are eye-bars on which the work would be, in a measure, independent of the length. The panels of the compressive chord are of equal lengths as well as those of the tensile chord, and this with an advantage to the web members.

In the forms of curved chord bridges now in use, the web bracing consists of vertical posts and inclined ties, or posts and ties forming isosceles triangles, in either of which constructions the assumption of equal panels for one chord makes the panels of the other chord unequal.

The greatest possible advantages are gained in the web members. At the middle of a span, the posts are small and should be as short as possible, in order to give them stiffness. They have a low allowable unit stress and are not capable of transmitting the shearing strain horizontally with economy. At the ends of a span, the posts are large and have a large allowable unit stress, and may be made to assist in transmitting the shear towards the piers. In the new truss the posts at the middle are vertical or nearly so and increase in inclination to the ends of the truss where they have the maximum inclination. In the two forms of present curved chord trusses, hereinbefore cited, the vertical post truss has a large variation in the lengths of the posts; and as they become large and short and have a large allowable unit stress, they are not made to assist in transmitting the shear horizontally and the ties are given unfavorably flat inclinations.

In the triangular braced truss there is also a great variation in length, and the posts, or more properly tie struts, near the middle of the span are long and slender and are, further, subjected to reverse strains. This latter objection it is proposed to overcome by the general use of ties and counter ties, as in the Pratt and Whipple trusses.

As a measure of economy comparisons are made with the Whipple truss because it is believed to be the cheapest, and so universally used in this country that it is properly a standard of comparison.

It is difficult to compare two trusses requiring different proportions. To properly do this, complete shop drawings should be made of what seem the best proportions of each for a given span, and the weight and cost of every detail carefully estimated, all conditions being the same. This has been done with the Whipple and the new truss, both deck and through, for spans of 250 ft. and 400 ft.

The actual saving in total cost is found to be about the same as the percentages in saving of total weight in the examples of 255 ft. spans given in this paper. Such evidence could not well be presented here, but to aid the reader in making a comparison the calculations, strain sheets and detailed weights of 255 ft. spans, deck and through, of the two forms, are herewith submitted, the spans being reduced to as nearly equal conditions as possible. The depth of the Whipple spans is taken as the average depth of the curved chord spans. To be fairly compared, the number of top chord panels in the curved chord truss should be the same as in the Whipple, but to simplify the matter by eliminating the floor members the number of panels in the *floor* of each is taken the same. This operates to the disadvantage of the curved chord through span, because a long bottom panel increases the curvature of the chord and thereby the saving in weight.

Complete data are given in the strain sheets, Plates 2 and 3. The calculations of the stresses in the through Whipple are given in detail in a contribution by the writer to the *Railroad Gazette* of Dec. 10, 1886, from which the stresses in the strain sheet are taken. The stresses in the deck Whipple are from the same source, modified for increased dead load and changes in the span. The stresses in the curved chord through truss are taken from Plates 4 and 7. The finished or "shipping" weights are as follows:

255 FT. THROUGH SPANS.

	Whipple.	Curved Chord.
Top Chord	129,217	112,018
Bottom Chord (eyebars)	64,861	76,834
Bottom Chord (stiff)	23,633	13,236
Ties and Counters	63,914	46,371
End Posts	33,437	30,433
Common Posts and Susp.	39,658	45,120
Truss Pins	7,625	6,300
End Post Struts	3,299	3,113
Total Trusses	365,644 lbs	333,416 lbs
All Other Iron	134,869	
Total Whipple	500,513	

255 FT. DECK SPANS.

	Whipple.	Curved Chord.
Top Chord	122,276	113,203
Bottom Chord	80,673	81,244
End Posts	37,492	31,787
Common Posts	51,556	52,154
Ties and Counters	66,707	47,983
Top Chord End Strut	2,942	2,942
Truss Pins	7,650	5,400
Total Trusses	370,344	334,683
Floorbeams	33,146	33,146
Stringers	62,416	62,416
Portal Struts	2,600	2,600
Common Struts	3,344	3,736
Lateral and Sway Rods	20,477	20,220
All other Iron	17,324	17,324
Total Span	518,551 lbs	473,130 lbs
SUMMARY.		
Trusses Proper	370,344	334,689
All other Iron	139,307	138,443
Total Span	518,551	473,130

Difference in Trusses = 44,556 lbs., or 11⅞ per cent.
Difference in Totals = 45 421 lbs., or 9⅝ per cent.

The item "all other iron" would be about the same for both spans, for whereas the curved chord has two more top struts, it has much shallower and lighter portal struts.

The difference in weights of trusses is 32,229 lbs., being $8\frac{1}{10}$ per cent. of the Whipple *trusses*, and $6\frac{1}{10}$ per cent. of the *total span*.

As previously stated, these percentages in the saving in weight fairly represent the saving in cost of fabrication, etc., and, therefore, in the total cost of the span. Some idea of the saving in shop work may be had by a close comparison of the strain-sheets; but, in doing this, it must be borne in mind that the curved chord through span is not as well proportioned as the Whipple. It should obviously have longer bottom chord panels.

It will be seen that the diagonal ties are much smaller in the curved chord truss and can be made in one length, while those of the Whipple cannot (50 ft. being assumed as the maximum length of eye-bars). The counter ties of the curved chord truss are long, but these are necessarily in two lengths, on account of adjustment, and therefore entail no extra expense. The top chords have smaller sections admitting of cheaper construction, thus the side plates of the Whipple chord are doubled throughout nearly its entire length, while they are doubled in only a few middle panels of the curved chord truss. The end-bottom stiff chord extends over but one panel of the curved chord truss, whereas it must extend over two of the Whipple and must be in one length or have a large tension splice either of which is expensive. The end-post, the largest member in the bridge, which is required to be in one length where practicable, is much shorter in the curved chord truss. The portal struts in the through curved chord are much smaller and simpler. The curvature of the top lateral bracing makes it, in effect, a portal strut 6 ft. deep.

In order to show the effects of increased curvature of the chord, and that the economy applies to spans of all lengths, the following cases of 180 ft. and 336 ft. through spans are given:

The spans are of the same general design as the 255 ft. spans shown on Plates 2 and 3.

180 FT. THROUGH SPANS.—All of these spans have 8 panels of 22.5 ft. The loading and specifications are the same as in the 255 ft. spans. The skeleton of the curved chord truss is shown in Fig. 10, Plate 1.

The shipping weights are,

	Curved Chord. Posts, 33 ft.	Whipple. Depth, 28 ft.	Whipple. Depth, 32 ft.
Top chord	36,637	48 330	43,089
Bottom chord	29,929	33,685	30,114
Ties and Counters.	18 687	28,033	26 886
Posts	39,066	39,796	44,187
Pins	37,80	4,410	4,410
Total Trusses	128,099 lbs	154.25 4lbs 128,099	147,686 lbs 128,099
Difference in Trusses		26,155	19 585
Difference per cent		17%	13$\frac{2}{10}$ %

The percentages of *total weights* of spans, taking the Whipple at 245,000 lbs. for 38 ft. depth, and 240,000 lbs. for 32 ft. depth would be 10 $\frac{7}{10}$ % and 8$\frac{2}{10}$ % respectively.

The 28 ft. depth is about the average depth of the curved chord truss, and the proper basis of comparison, but the 32 ft. depth is given to show the saving over a Whipple of practically the same greatest depth.

336 FT. THROUGH SPANS.—Curved chord truss with circular arc chord; radius, 804 ft. Panels, 24 ft. Depth at middle, 45 ft. Depth at end, 32 ft. Width, 22.5 ft. Skeleton shown in Fig. 11, Plate I.

Compared with Whipple 38 ft. deep and having 21 ft. panels. Proportioned under specifications of St. Lawrence River bridge at Lachine, published in ENGINEERING NEWS of Oct. 10, 1885, which, in brief, require a live load of two Utah Consolidation engines (24,000 lbs. on driving, and 21,250 on tender axles) and stresses in iron at 10,000 lbs. tension, and 8,000 lbs. compression, reduced by the usual column formulas; and in steel, at 12,000 lbs. tension, and 10,000 in place of 8,000 in the iron column formulas for compression.

All parts are steel except floorbeams, struts, counter ties and some of the intermediate posts (about half the number.)

The shipping weights of the entire spans are:

	Curved chord	Whipple
Steel	653,422	780,685
Iron	179,940	163 810
	833,362 lbs.	944,495 lbs.

The difference is 111,133 lbs. or 11$\frac{8}{10}$ per cent. of the Whipple.

If made 45 deep, the Whipple would weigh 899,635 lbs.; making the difference 66,273 lbs. or 7$\frac{4}{10}$ per cent. This depth is not as good or as cheap as the 38 ft., but is given as an interesting comparison.

The saving in shop work is also very great, as the large ties at the ends of the truss are in one length in the curved chord truss. It must be noted that the posts of this truss are not of equal lengths; but, the greatest difference in those of one class is only 2 ft.; thus the end post is 40 ft. long; the next three posts run from 41 to 43 ft. and the other posts from 43 to 45 ft. The saving offered by the new truss in the cost of *transportation*, especially by water, would be proportionately greater than the saving in weight on account of the lighter single pieces and shorter lengths. Thus the end post, the largest member in the bridge, is considerably shorter and the top chord sections are lighter as well as shorter. This will also apply to *erection* where the handling of top chord sections is a difficult part of the work.

In *deck bridges where the chords are used as stringers* the panels should be short. This is attained in the new truss without the shorter bottom chord panel, necessary in a Whipple, and would render the curved chord truss especially economical in such cases.

LONG SPANS.—A large bridge, scientifically constructed, should differ, fundamentally, from a small bridge. It requires very little genius, but frequently a large amount of money, to build what has been termed a "big little bridge," that is, a bridge which contains simply the features and details of a small bridge on a magnified scale.

The machinery of our work shops, the means of transportation and the appliances and methods of erection, are adapted to the current work they have to do, which they are, therefore, better able to do than any other. When working to the limit of their capacity, they labor at a great disadvantage in cost and excellence, and when special machinery has to be devised and unusually large weights handled, the cost is out of all proportion to the results attained. The economic advantages of the new truss increase with the span and in very long spans it admits of a construction, giving very decided advantages. This is illustrated by the proposed 650 ft. span, shown in Fig. 12, Plate 1., which exceeds the largest span built by 125 ft. in length. This span might be built by any of our large bridge shops without special tools or even inconvenience. The bottom chord panels are about 27 ft. long, and the top chord panels 23 ft. The panels of each chord are of equal lengths throughout.

There is a double system of web bracing, similar to the Whipple, in the middle portions of the truss, which is sub-divided into a quadruple system in the end portions in order to reduce the large cumulative strain in the posts, thus making them of more uniform and lighter construction, and also to give the ties a flatter inclination for a more economical transmission of the web strains to the piers. The division of the strain between the systems is accomplished by links, first used in the Kentucky River bridge. This division is statically determined by the directions of the ties at their intersection.

The slight variation, which might arise from errors of workmanship and deflection, would be compensated in the large amount of dead load carried by these members in proportion to the live; the small effects of impact through the long train motion required to produce the maximum stress, and the improbability of a frequent application of the maximum loading.

The intermediate posts are 75 ft. long, throughout. They should be built in two lengths at the shops, carefully faced and joined with splices with turned bolts before the pin holes are bored, and should be match-marked to insure the same fitting in the field. They can then be taken apart for shipment.

Where practicable, it would be better to rivet the parts together in the shops, but the dangers and difficulties of transportation to such long and comparatively slender pieces would generally render this undesirable.

The line along the middle of the truss, shown in the figure, represents a double line of rods to stay the posts, a device which has been often used.

TO BE CONTINUED.

Replacing the Stone Towers of the Niagara Railway Suspension Bridge with Iron Towers.

The railway suspension bridge at Niagara Falls, a work which made famous the name of JOHN A. ROEBLING, has done good service for years, but circumstances have made necessary the replacement of the original stone towers by other towers of iron, and the methods of this very delicate feat of engineering have been detailed in a paper read before the American Society of Civil Engineers on Nov. 3 by Mr. L. L. BUCK, who designed and most successfully carried out the work described. The following is an abstract of Mr. BUCK's paper with some further illustration, for which we are indebted to him:—

The original stone towers had a height, from rock to center of cable, of 90 ft. on the New York side of the gorge, and 80 ft. on the Canadian side. Each pair of towers had a base of rock-faced ashlar extending to about the top chord of the stiffening trusses of the bridge, and were there connected by an arch which supported the railway track and permitted the passage of vehicles and pedestrians on the lower floor, the bridge having thus a two-storied roadway over its span of 821 ft. The general dimensions of the towers were 15 ft. square at the base, and 8 ft. at the top, and their form is shown in dotted lines on Fig. 1. They were built of dressed limestone laid in cement mortar.

On top of each tower was a cast-iron bed-plate 2½ in. thick covering the whole area. And on top of this plate were cast three ribs, 2½ in. thick by 7½ in. high, parallel to the cables and extending across the whole plate. The two 2 ft. 10 in. spaces between the ribs were truly planed on bottom and sides, and in each were placed 10 cast-iron rollers turned to 5 in. diameter and 2 ft. 1¾ in. long. These rollers were laid close together, and each set supported a cast-iron saddle 5 ft. long by 2 ft. 1¾ in. wide on the base. The upper sides of these saddles were grooved for the cables, and they were each pierced by 9 cored holes as shown best in the isometrical view Fig. 2. This sufficiently explains the original tower and saddles.

The reasons for making the change came about as follows: The limestone used in the old structure was quarried near the site of the bridge, and while the stone from the upper stratum, which was used in the base of the towers, remained sound, the stone taken from a lower stratum did not weather well. Not very long after the completion of the bridge the masonry began to spall and crack in various places and painting was resorted to as a preservative.

In 1877 Mr. BUCK was called in to renew and strengthen the anchorage of this bridge (See Proceedings Am. Soc. C. E., Vol. VII, 1881) and he then noticed that there was considerable disintegration of the stone in the towers, and cracks running in every conceivable direction. New face stone had been inserted from time to time, but in 1880, while rebuilding the suspending superstructure, the author of the paper paid more particular attention to the condition of the towers and found that the most defective parts were located about one-third of the height from the railway floor to the top; above and below this point the disintegration gradually decreased. From these indications he assumed that the towers were subjected to a considerable bending stress which would fully account for the failure of the stone.

The cause of this bending was the contraction and elongation of the cables between the towers and anchorage under the live load and changes in temperature. This part of the cable was nearly straight, having a deflection of only 15 in., and the maximum movement at the saddle, produced by live load, is about ⅝-in., while that produced by temperature is a little over 2-in. As these two act in concert only at the higher temperature, the greatest movement of the saddle at extreme high temperature would be about 1⅜-in. from a normal position towards the river; and at extreme low temperature it would move in the contrary direction about 1-in.

On the completion of this other work Mr. BU

was asked to report upon the towers and the best means of remedying their defects. The only plan which seemed to him to promise success was to cut away the defective parts and reface the towers with new stone, thoroughly anchored to the interior portion, which was then considered to be sound, and to cement and grout all interstices. His report favored this plan as an experiment, and in 1883 this refacing was completed.

But cracks again appeared on the face of the towers in the new and old stones. In September, 1885, Mr. BUCK again examined the structure and found the stonework in a bad and even threatening condition. At this time all motion of the saddles on the rollers had ceased, and while this could have been remedied by lifting the saddles and replacing the old rollers by a larger number of less diameter, and then refacing the towers, this was expensive and the internal condition of the towers would be still uncertain. Then, too, the area of distribution of the load on the towers could not be effectually increased to more than 25 sq. ft. over the old 18 sq. ft. by any new arrangement of bed-plate and rollers. The maximum weight on the rollers was about 900 tons, or 36 tons per sq. ft. on the masonry. Under this pressure there was a strong probability that the interior stones at the top were unsound. These considerations induced the author to recommend replacing the stone towers with iron.

Plans were consequently prepared, and the bridge directors having decided to act upon the recommendation, the contract for the iron work was let to the Detroit Bridge & Iron Works. The general dimensions and plan of these metallic towers is shown in the accompanying illustrations. Each tower was made up of four wrought-iron columns, resting upon a limestone pedestal, capped with granite, and braced together as shown in Fig. 1. The tops of each pair of columns were connected by a heavy web-plate secured to the column web by angles and riveted, and the cap of each column was a wrought-iron plate planed to present a level surface when in position. On these caps rests the main bed built up of wrought-iron plates and angles, as shown in Fig. 3. This bed is 9 ft. 2 in. long, 5 ft. 3 in. wide and 3 ft. 8 in. high, and it weighs about 9½ tons. The whole top surface is truly planed, and on it are laid without any fastening, two steel plates, each 2 ft. 2 in. wide, 7 ft. long and ⅞ in. thick, with both sides and edges planed parallel and laid with the length in the direction of the cables. On top of these plates are eighteen steel rollers, laid transversely, turned true to 4 in. diameter, and with their ends having trunnions which enter into holes in the side pieces of the roller frame. These side pieces are 1 in. thick by 5¾ in. wide and have the inner faces planed where they meet the steel plates. On the rollers rests a casting 7 ft. long, 2 ft. 4 in. wide and 18 in. high, with a top 5 ft. 2 in. by 2 ft. 2 in.; the top and bottom of this casting is planed parallel and to the under surface is riveted a steel plate covering the whole surface. This arrangement protects the rollers from water and as much as possible from dust. On this casting the old saddle was to rest.

When the columns of the tower had been erected the transverse bracing only was put in, and as the longitudinal bracing could not be set up until the stone towers were removed, the place of this bracing was temporarily supplied by clamping the iron work to the stone. Now came the preparatory work for the transfer of the load. Four temporary cast-iron columns were set up, one over each main post (see Fig. 3) and with their tops extending above the cables. On top of each pair of iron columns came a transverse girder and these in turn carried two lifting girders placed over the saddle. Each saddle was then secured to the lifting girder by passing 350 turns of a fine quality of No. 8 cast-steel wire through the 9 cored holes in the old saddle and over castings resting on the bent members of the lifting girders.

The lifting was done by six hydraulic jacks of 125 tons capacity each, set under the transverse girders. The new plate bed was first hoisted on the side towards the river and put on a temporary platform just under the cables as shown in Fig. 3 ready to be put in place when required. The six jacks were then operated simultaneously and lifted the upper girders and with them the saddles and cables; as these girders were lifted, iron shims were inserted between these and the corner posts until the saddles were clear of the old rollers. The jacks were then discharged and the weight rested on the iron work. The old bed was now raised clear of the masonry and suspended by rods to the lifting girders, and the upper three courses of masonry removed. The jacks were next removed and into the clear space thus left the new wrought-iron bed was moved, set in place and bolted to the caps. The old bed was then lowered and placed on the temporary platform and the old rollers taken out and thrown to the ground. The steel plates, new rollers and saddle beds were now put in place, the jacks set up again, the transverse girders lifted sufficiently to remove the shims, and finally the old saddles and their load were allowed to settle permanently on the new bed resting on the iron tower. Each of the four towers were successively treated in the same way.

The stone towers were then removed and as they were taken down the struts and rods were put in place. With all preparations completed it took 8½ hours to transfer the load and remove the top three courses of masonry. No trains were allowed on the bridge during this time. The six jacks raised a total weight of about 650 tons with two men at each jack to operate it.

In taking down the masonry at the tops the stones were found to be cracked through vertically and badly shattered and some were found to be only half

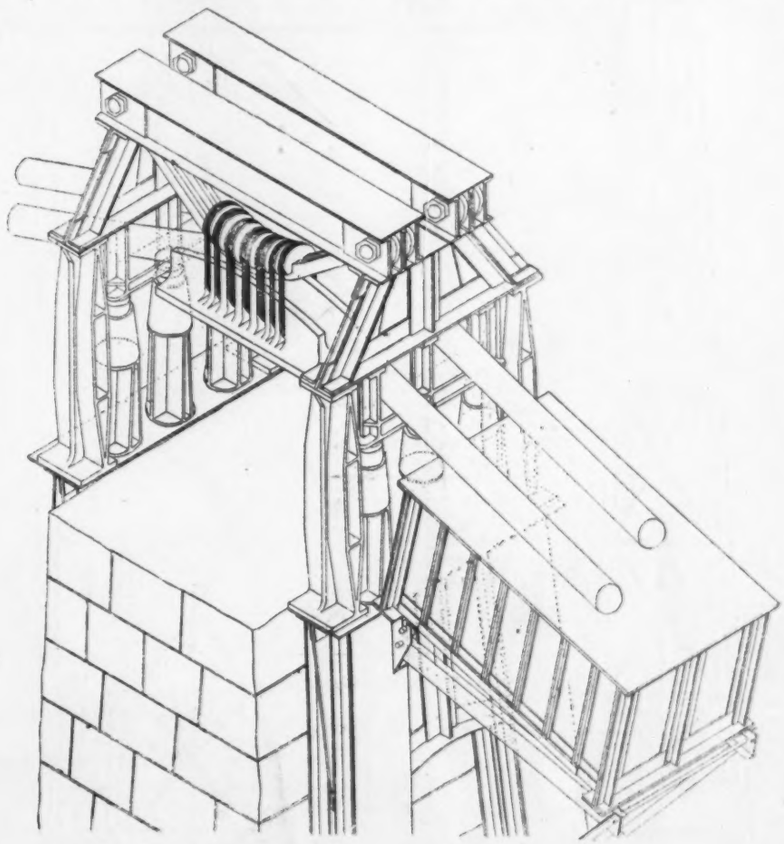

Fig. 2.—Isometrical View of Transfering Apparatus.

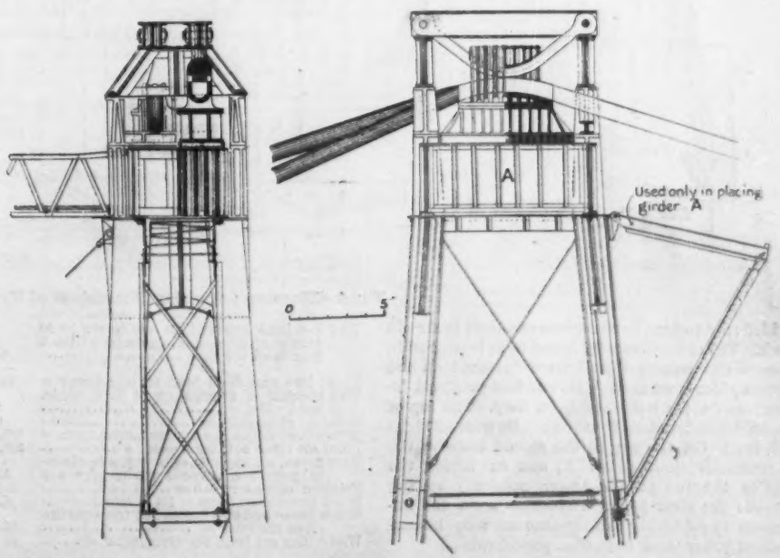

Fig. 3.—Showing New Bed-Plate, etc., in Position.

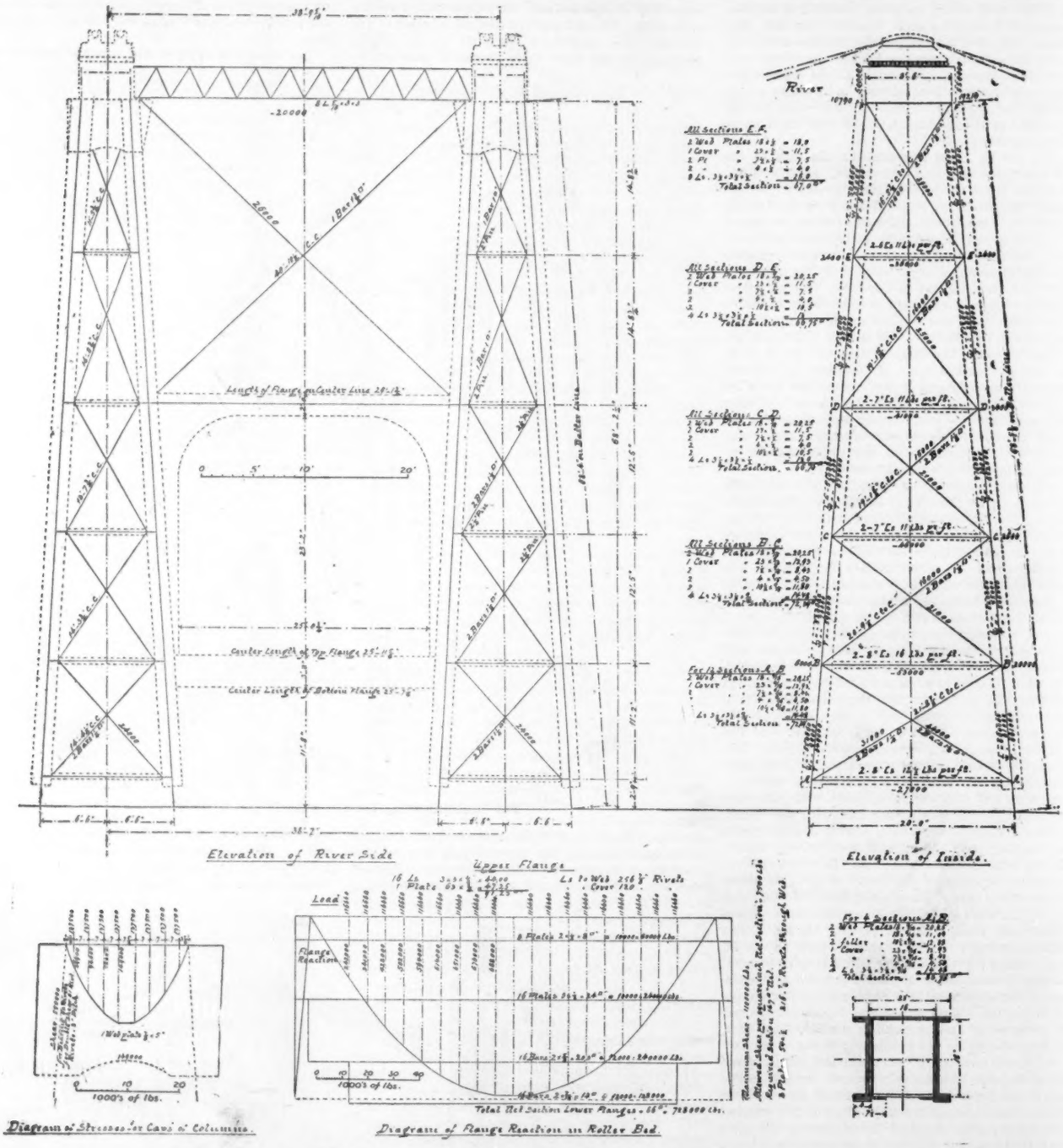

Fig. 4.—Diagrams; Showing Dimensions of Members, etc.

bedded; the cement however was excellent in the old work. The old rollers were found to be imbedded in cement and iron-rust and were flattened on the bottom sides more than $\frac{1}{32}$ in. and had produced depressions in the bed-plate $\frac{1}{32}$ in. deep. The top of the rollers and underside of the saddle were all right and true. On the day of the second transfer the thermometer stood at + 7° *F*, and on lifting the saddles the top of the tower suddenly sprung towards the river $\frac{5}{8}$ in. The stress upon the anchorage in producing this bending can only be conjectured but it must have been considerable.

The diagram sheet, Fig. 4, gives the dimensions of the various members and parts of the new iron towers, and also several stress diagrams. Without going into the mathematics of the problem of transfer of cables, we give the data for calculating the stresses, as used by Mr. BUCK. This data is as follows:

The total suspended dead load on one tower =	613 tons.
The live load brought on one tower by 20 cars of 30 tons each, extending over a length of 640 ft. =	437 tons.
Total live and dead load on one tower =	1050 tons.
The tangent of inclination of N. Y. cable, land side, =	0.4
Same on river side, =	0.3
Hence the load on the land columns, each, =	350,000 lbs.
Load on river columns, each, =	500,000 "
This gives, on account of batter, a horizontal pressure towards the river = *a* =	4,210 lbs.
Friction of rollers = *b* =	10,000 "
Wind pressure at top = 125 × 40 = *c* =	5,000 "
When these last two forces act towards the river the total =	19,210 lbs.
When they act from the river, total =	10,790 "

TRANSVERSE STRESS.

The transverse stress is assumed to be as follows:

1st. By deflecting the pressure of the total load on top of the tower from the vertical, $= \frac{.25}{60} = .004166$, due to the middle of the suspended superstructure swinging 6 in. out of line by wind =	8,750 lbs.
2nd. By a pressure of 30 lbs. per sq. ft. of diameter of two cables, for a length of 100 ft. each way from the tower =	6,640 lbs.
3rd. By a pressure of 40 lbs. per sq. ft. on the surfaces of the tower itself = (for the top)	3,610 lbs.
The sum of these pressures gives the total for the top of the tower =	19,000 lbs.

MAXIMUM STRESSES PER SQ. IN.

		lbs. per sq. in.
Roller-Bed.	Web-shear, net section	7,500
	Angles, compression, gross	9,000
	Bars, tension, net	12,000
	Plates, " "	10,000
Columns, compression, gross		9,000
Tie-rods, tension		15,000

Under each saddle are 18 rollers, 4 in. diameter by 2 ft. 2 in. long; of steel, resting on steel plate; or 36 rollers to each tower.

The tie rods are somewhat larger than the stresses call for, as in time the rollers will, from an accumulation of rust, etc., be obstructed to some extent and cause increased stress on these rods.

The stresses on the horizontal struts are those due to the combined action of all the rods having an initial stress of 10,000 lbs. per sq. in. in each case.

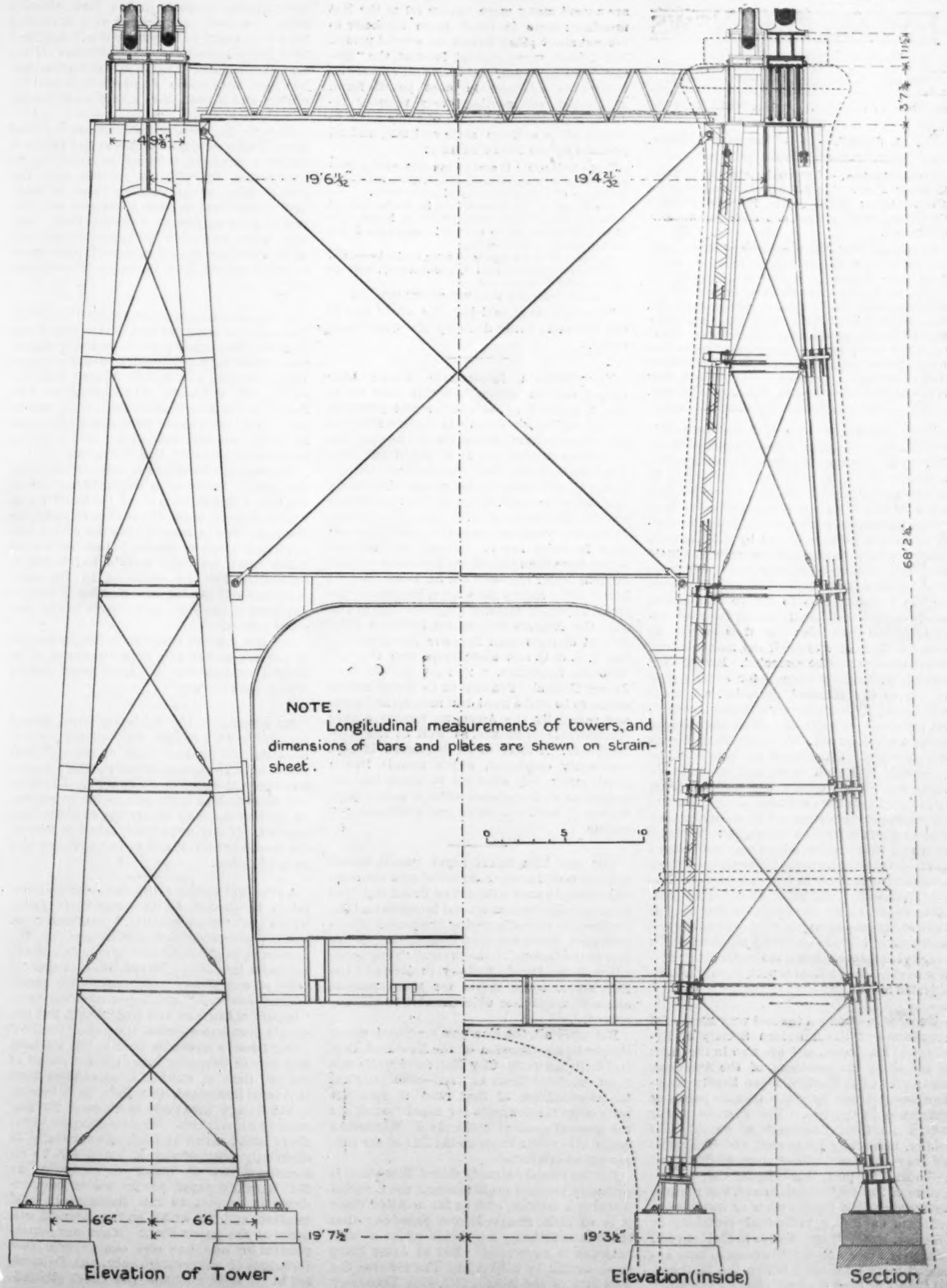

Fig. 1.—Niagara Railway Suspension Bridge; General Elevation of New Iron Tower.
L. L. Buck, M. Am. Soc. C. E., Engineer.

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

THE Committee to select an automatic coupler for some 35,000 miles of road, of which Mr. W. P. SHINN is chairman, have submitted a report which we have the less regret in being utterly unable to find space for this week because its final conclusion is that "none of the couplers presented fulfill the conditions requisite to adoption by this Committee," and they have therefore granted a little more time to prepare further tests. We have grave doubts as to whether the facts presented by the Committee as to failure of couplers under impact tests really justify their conclusion, further than this: that it is as well to wait a little longer to see if the more obvious weaknesses cannot be corrected. But we have already waited long enough for some genius to evolve the assumed necessity, a coupler which will, (1) perform very delicate mechanical functions perfectly, and (2) resist smashing under a trip-hammer. We have serious doubts whether these two alleged essentials can be reconciled with each other, and the most obvious, and we believe the only mode of doing so in effect is to stop exposing freight cars to the barbarous trip hammer blows which now cost so much in broken draw-gear. We trust above all that the Committee may not be used as an instrument by those interested patentees who are now behind in the race to gain time for a probably vain effort to catch up with those ahead, by the specious plea that none of the couplers are ideally perfect—What work of man's hand is?—and so delay all progress for some years more. But a moderate delay of a few weeks before a final report, should not be objected to.

THOSE who attended the last very successful convention of the American Society of Mechanical Engineers, and are also in the habit of attending the meetings of the American Society of Civil Engineers can hardly fail to have been struck by some notable points of difference in the two. The average paper before the Civil Engineers is a good deal longer, more fully illustrated, and we believe we may truly say, rather more weighty and valuable. In part, this may be due to the nature of the subjects discussed, but there is no denying that papers more or less open to criticism as airing individual crotchets or schemes, or merely speculative in their nature, or merely rehashing old information, have appeared more frequently before the Mechanical than the Civil Society. But on the other hand, there are many points of comparison decidedly favorable to the Mechanical. There are a good many more papers (20 at the last meeting); there is much more tendency to present short pithy papers on special points, indicating a more general interest, the "get-up" is rather better, and above all *they are all printed in advance*, in neat paged form. Before the last meeting every member received a package of twenty of these advance sheets, all in uniform style and size, and all prefixed by the following note:

> NOTE.—This paper is sent to you that you may examine it in advance of the meeting, and prepare any discussion of it which you may wish to present.
>
> It is issued to the membership in confidence, and with the distinct understanding that it is not to be given to the press, or to the public, until after it has been presented at the meeting.
>
> As there will be no supply of extra copies there, and papers are liable to be read by abstract only, preserve this copy for your use, and
>
> BRING THIS COPY WITH YOU TO THE MEETING.

This is as it should be. We would like to see the same thing done by the Civil Engineers.

THE Baldwin Locomotive Works have turned out 593 locomotives this year up to Dec. 1, and the whole number will probably be 653, which we believe is considerably the largest output ever turned out in one year. Up to 1880 the largest output by far in one year was 518 which was then regarded as phenomenal. All this work has been done with hardly any over-time work, although the remarkable electric light plant of 2,700 lights, the largest at any one works in the world, gives all necessary facilities for it. Among the oddities which have been turned out have been a small vertical boiler tramway car for Tokio, Japan; (made lower height than here, because of the small Japanese stature) a similar one to run over the Niagara Suspension bridge, a lot of 20 × 24 engines with Belpaire fire-boxes for the C. B. & Q. and some more with the vast Wootten fire-boxes, 8 × 8 ft., for the New Jersey Central. Practice as to driver brakes seems to be still a good deal mixed, the Eames and especially the American having a very considerable patronage, as well as the Westinghouse. A force of 35 draftsmen is kept constantly employed, which sounds like a good many, but after all it allots but one draftsman to 19 engines, which is hardly more than two week's work of one draftsman per engine.

THE new Elm Street rapid transit tunnel scheme would seem to do away with the chief objections to such a tunnel on Broadway; that is, the damage to commercial interests and the obstruction to traffic during the period of construction. These two considerations are doubtless at the bottom of the present strong opposition to the Arcade Railway project, and the Elm street route would for these reasons alone be much less objectionable to all concerned.

But after all, the line now proposed would simply be an extension of the New York Central Railroad to the City Hall; and while this is an excellent thing in itself—especially for the stockholders of that road—it does not fully meet the demands for rapid transit for the general good of residents of Manhattan island other than those on the line of the railroad most interested.

For the reasons already stated, Elm street is probably the best route through the crowded downtown district, and as far as Astor Place it is so little removed from Broadway that there is practically no choice so far as convenience is concerned. But at Astor Place there should be a diverging line towards the west side of the island, following Broadway as near as may be and striking Eighth avenue as soon as possible. There is a strip of the best building property in New York, almost 4 miles long, and including all west of Central Park that would be very little if any benefited by a rapid transit line lying entirely to the east of the park. And it is this section that just now most loudly demands increased facilities, and it must have it very soon in some acceptable shape.

Though the company's interests involved are probably as much at odds as any two rival schemes could be, it would be more wise to pool issues between the Arcade and Elm street routes, as far as Astor Place, at least; and beyond that let each go its own way, one east and the other west of Central Park. Two lines down town might be needed in time, but when built they should be much further apart, for good service, than the two routes referred to.

IT also now appears that a tunnel under the Hudson river is a vital part of this Elm Street project. Space only permits us to say that as the avowed purpose of such a tunnel is to convey passengers and freight directly from the system of railroads terminating in New Jersey to the New York Central, there will be some lively work ahead for the traffic manager if he is to combine this service with a proper and acceptable rapid transit system.

The report also does not state the depth of the rock to be tunneled below the surface of the river; this depth is about 175 ft. off Washington Square, some distance further up the Hudson. The statement that the rock found is without break or fissure," must likewise be taken with a very wide margin, as it is simply impossible for any engineer by the most elaborate and careful investigation to foretell anything of the kind, as we know to our personal sorrow.

But the scheme seems to be amply backed by capital, and in this sense is ahead of its several competitors. We shall await results with much interest.

BY an error in the bindery a small part of our last week's edition was mailed without inserting the progress map of railroad construction in the Southern States, which should have been included in every copy. The error was immediately corrected, so far as known, by mailing the map separately to those thus omitted. If any subscriber failed to receive the map, however, it will be forwarded to him on application.

A KIND and valued subscriber, who may certainly be classed as an undoubted expert, writes us "confidentially," cautioning us against accepting the conclusions of Mr. RAMSEY as to effects of cold on iron, as given in his paper recently published, alleging that "it takes no new theory to account for the peculiarities observed," and hence advising us to "beware of the frost and iron theory, lest you should drop into a pitfall of errors."

Our friend's advice is kindly, but we have less fear of dropping into even a "pitfall of errors" than of waiting to summarize facts that seem important, until they have become so old a story that there is no room for any error in conclusions. We do not expect to entirely avoid error, and are always ready to cheerfully acknowledge it, but it will be remembered that we based our comments on Mr. RAMSEY's paper wholly on outside evidence in respect to rail fractures in cold weather, and not at all on the internal evidence of the paper itself. When our correspondent or any one else can explain how variations of temperature only, *with the roadbed in the same condition*, can cause continuously a corresponding variation in the number of broken rails reported from day to day with-

AREA WORK OF BRIDGE CREWS

NEW FORM OF BRIDGE TRUSS.

DESIGNED BY GEO. H. PEGRAM, M. AM. SOC. C. E.

PLATE I.

A NEW TRUSS FOR BRIDGES AND ROOFS

EXPLAINATION.

THE PANELS ARE OF EQUAL LENGTHS IN EACH CHORD OF ALL OF THE FIGURES.
THE POSTS ARE OF EQUAL LENGTHS IN ALL OF THE FIGURES EXCEPT 6, 9 AND 11 IN WHICH THE CHORD IS A CIRCULAR ARC

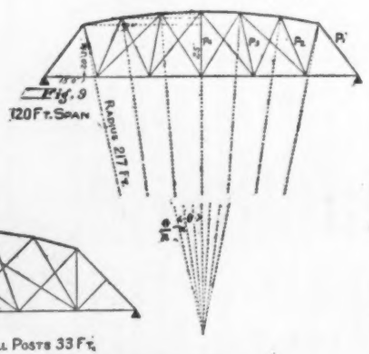


Fig. 9
120 FT. SPAN

Fig. 5

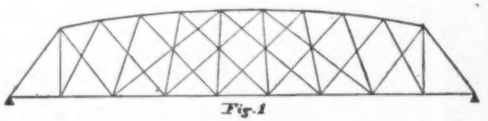


Fig. 1

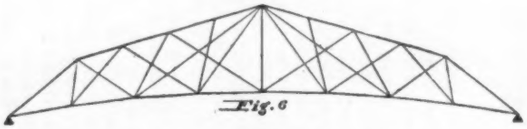


Fig. 6

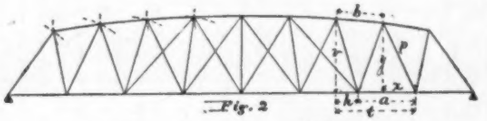


Fig. 2

Fig. 10
180 FT. SPAN, BOTTOM PANELS 22.5 FT. ALL POSTS 33 FT.

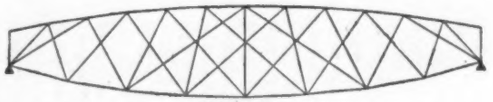


Fig. 7

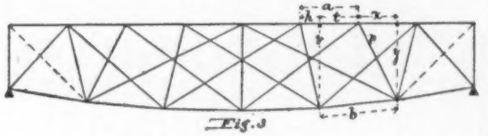


Fig. 3

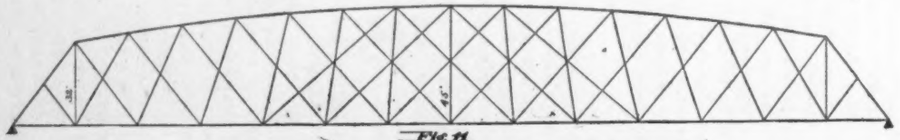


Fig. 11
336 FT. SPAN.—BOTTOM PANELS 24 FT.—CIRCULAR ARC CHORD & RADIUS 804 FT.

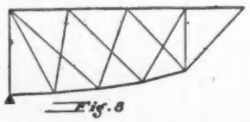


Fig. 8

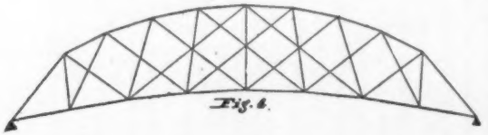


Fig. 4

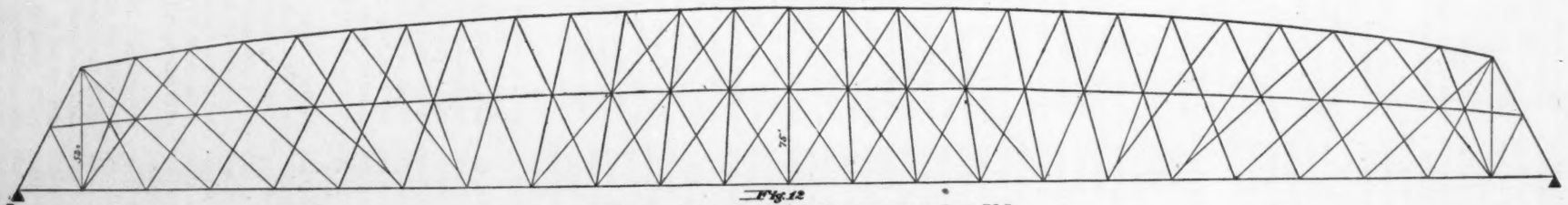
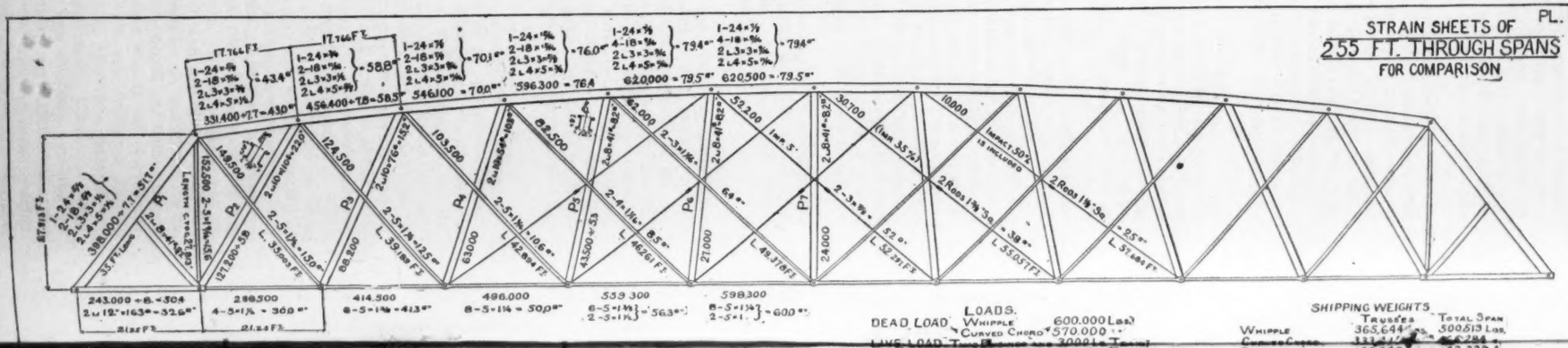


Fig. 12
650 FT. SPAN.—BOTTOM PANELS 27 FT. 1 IN.—INTERMEDIATE POSTS 75 FT.

PLATE No. 1

PL. II.

STRAIN SHEETS OF
255 FT. THROUGH SPANS
FOR COMPARISON



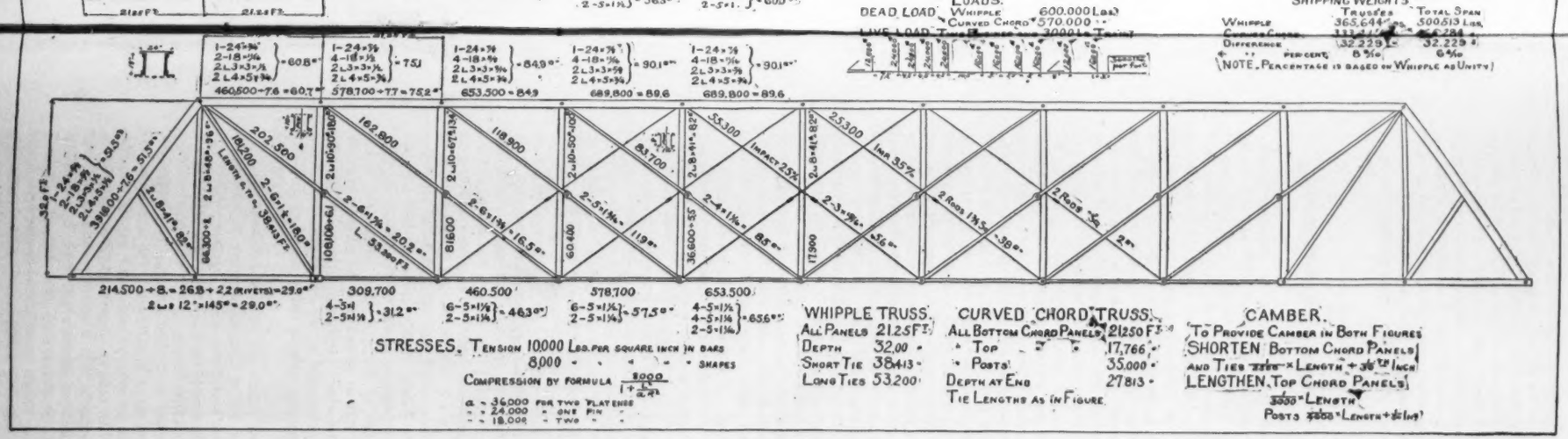

WHIPPLE TRUSS.
ALL PANELS 212.5 FT.
DEPTH 32.00 "
SHORT TIE 38.413 "
LONG TIES 53.200 "
CURVED CHORD TRUSS.
ALL BOTTOM CHORD PANELS 212.50 FT.
" TOP " " 17.766 "
" POSTS " " 35.000 "
DEPTH AT END 27.813 "
TIE LENGTHS AS IN FIGURE.
CAMBER.
TO PROVIDE CAMBER IN BOTH FIGURES
SHORTEN BOTTOM CHORD PANELS AND TIES 1/2500 × LENGTH + 1/50 INCH
LENGTHEN TOP CHORD PANELS 1/3000 × LENGTH
POSTS 1/4000 × LENGTH + 1/50 INCH
STRESSES. TENSION 10,000 LBS. PER SQUARE INCH IN BARS
8,000 " " " " SHAPES
COMPRESSION BY FORMULA 8000 / (1 + L²/a r²)
a = 36000 FOR TWO FLAT ENDS
" = 24000 " ONE PIN "
" = 18000 " TWO " "
DEAD LOAD. WHIPPLE 600.000 LBS.
CURVED CHORD 570.000 "
LIVE LOAD TWO ENGINES AND 3000 LBS. TRAIN
SHIPPING WEIGHTS.
TRUSSES TOTAL SPAN
WHIPPLE 365,644 LBS. 500,513 LBS.
CURVED CHORD 333,412 " 466,284 "
DIFFERENCE 32,229 " 32,229 "
" PER CENT. 8 9/10 6 9/10
NOTE. PERCENTAGE IS BASED ON WHIPPLE AS UNITY.

PLATE No. 2.

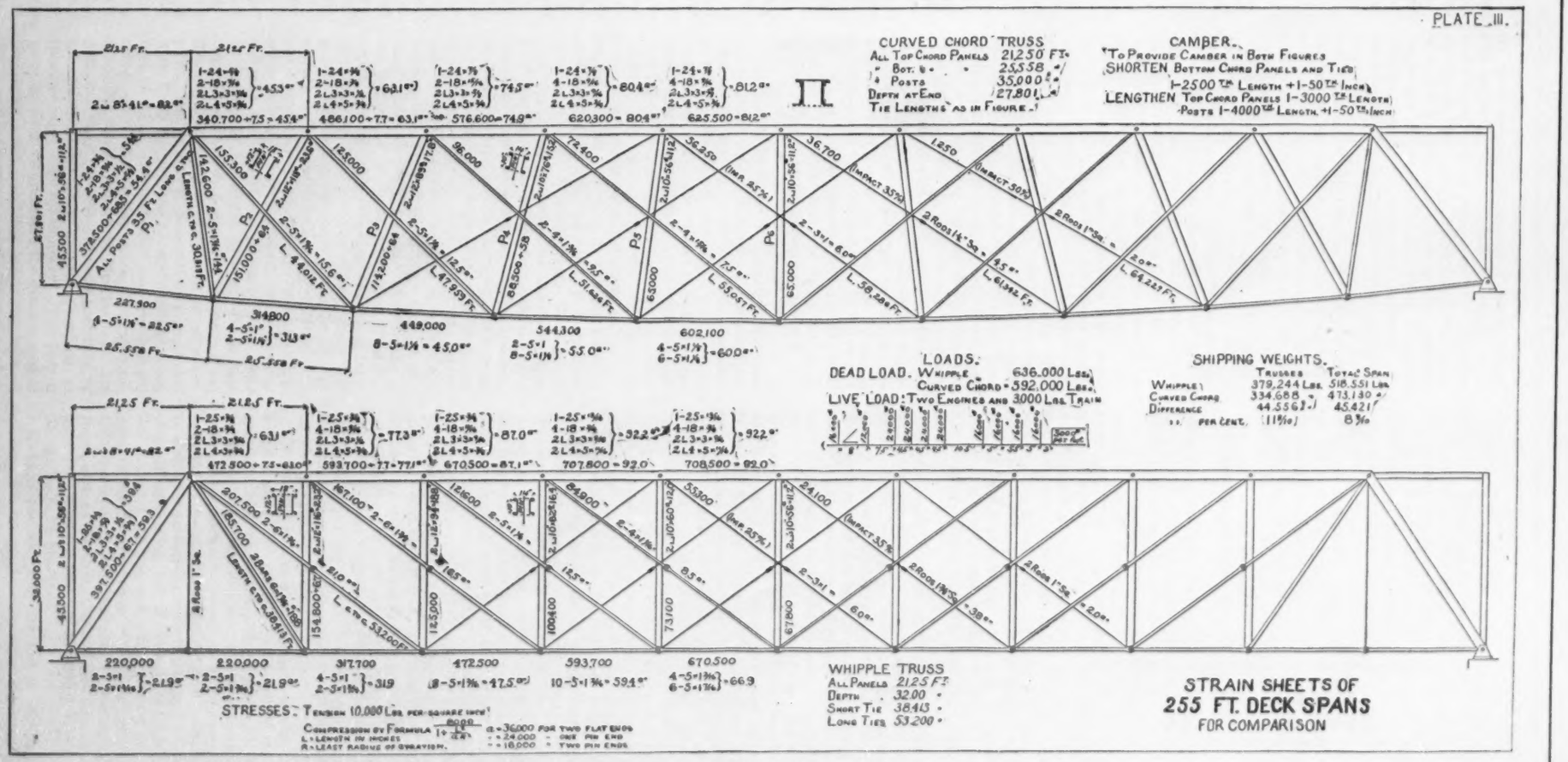


PLATE III.
CURVED CHORD TRUSS
ALL TOP CHORD PANELS 212.50 FT.
" BOT. " " 25.558 "
" POSTS " 35.000 "
DEPTH AT END 27.801 "
TIE LENGTHS AS IN FIGURE.
CAMBER.
TO PROVIDE CAMBER IN BOTH FIGURES
SHORTEN BOTTOM CHORD PANELS AND TIES 1/2500 LENGTH + 1/50 INCH
LENGTHEN TOP CHORD PANELS 1/3000 LENGTH
POSTS 1/4000 LENGTH + 1/50 INCH
LOADS.
DEAD LOAD. WHIPPLE 636.000 LBS.
CURVED CHORD 592.000 LBS.
LIVE LOAD: TWO ENGINES AND 3000 LBS. TRAIN
SHIPPING WEIGHTS.
TRUSSES TOTAL SPAN
WHIPPLE 379,244 LBS. 518,551 LBS.
CURVED CHORD 334,688 " 473,130 "
DIFFERENCE 44,556 " 45,421 "
" PER CENT. (11%) 8 3/10
WHIPPLE TRUSS
ALL PANELS 212.5 FT.
DEPTH 32.00 "
SHORT TIE 38.413 "
LONG TIES 53.200 "
STRESSES. TENSION 10,000 LBS. PER SQUARE INCH
COMPRESSION BY FORMULA 8000 / (1 + L²/a r²)
L = LENGTH IN INCHES
R = LEAST RADIUS OF GYRATION.
a = 36000 FOR TWO FLAT ENDS
" = 24000 " ONE PIN END
" = 18000 " TWO PIN ENDS
STRAIN SHEETS OF
255 FT. DECK SPANS
FOR COMPARISON

PLATE No. 3.

out there being a difference in the molecular condition of the metal which varies its susceptibility to fracture, we shall be prepared to accept his view. Until then we are compelled to believe that the chances favor there being an error in the scientific tests (or rather in the interpretation of them—a very different matter) than in the vastly more extensive practical tests. That there was any certainty of error on either side, we certainly have never asserted.

Southern Railroad Extension.

The summary of work in the Southern States for the first 11 months of 1887, given in our last issue, show 1,328 miles of new road completed, 3,718 miles in process of construction, 6,057 miles located and under survey, and 7,074 miles projected with fair probabilities of construction. These are the most accurate statistics indicating the extent of the new industrial activity in the South that have yet been published. As shown on the map, the center of greatest activity has been the "Magic City" of Birmingham, Ala., and the total of 437 miles of track laid in the State of Alabama, which is nearly treble the mileage ever laid in any preceding year and a full third of the completed work in all the Southern States for the present year, shows how rapid has been the growth of Birmingham, Decatur, Sheffield, Florence, and other cities in the mineral regions of the State. That the prosperity of these centers has a substantial basis, is evidenced by the manner in which conservative corporations like the Kansas City, Memphis & Birmingham, the Louisville & Nashville, and the Central of Georgia have pushed their extensions to these cities, already well supplied with transportation lines, at an outlay of capital which can only prove profitable if a heavy traffic is obtained and held.

But with the lines already built and those under way, northern Alabama will be well supplied with railroads, and it seems likely that most of the projectors of further competing lines in that section will be disappointed in their efforts to obtain capital. The centers of most active work during the coming season, it seems probable, will be in the mineral regions farther northeast, about the cities of Chattanooga and Knoxville and the Cumberland and Big Stone Gaps. The mineral deposits of eastern Kentucky and Tennessee and the adjacent portions of the Virginias and Carolinas are of undoubted value; and the numberless schemes for their development are promising enough to secure the aid of capital sufficient to complete the lines now under way, as well as some others which are now only in embryo. The other general features of the map need only a word of reference. Work is seen to be very active in the regions already best supplied with railroads, while the coast belt and the State of Mississippi seem likely to increase their scanty mileage very slowly.

Of the actual construction under way and completed, a very large part is the work of the great systems. The sea board Air Line has completed 45 miles of road and has 50 more under contract. The projected extensions to Knoxville and Augusta have both been partly surveyed and are quite likely to go on. The Atlantic Coast Line has completed 33 miles and has 69 under contract. It also will have a line to Augusta within a few months. The Richmond & Danville system, including the Georgia Pacific, has completed 80 miles of track and has as much more under contract. The Charleston, Cincinnati & Chicago road is to extend when completed from Ashland, Ky., to Augusta, Ga., and Charleston S. C. About 175 miles are now in process of construction and about the same mileage is located and under survey. Of the other lines from Augusta northwest, the Carolina, Knoxville & Western, of which 115 miles are nearly graded and the remainder of the line to Knoxville is under location, seems to have good prospects of completion. The Georgia, Carolina & Northern is another enterprise which has seemed to be well sustained and but for the scarcity of capital, which has retarded work in all parts of the country for the past few months, would doubtless have been pushed as actively this season as its projectors anticipated.

In Georgia several new lines, which we note, are at present stranded on account of lack of funds. The Augusta & Chattanooga, Covington & Macon, Rome & Decatur are all in the hands of receivers, but the creditors will probably complete the last two. The Birmingham & Atlantic Air Line, an enterprise of very large size, seems likely to follow the course of its predecessor, the Savannah, Dublin & Western; but the first division is nearly completed and should be carried through soon by some company. The Georgia Midland & Gulf and Americus, Preston & Lumpkin have pushed their lines vigorously during the past season, and seem likely to build their surveyed extensions soon. The Chattanooga, Rome & Columbus, Atlanta & Florida, and Georgia Southern & Florida are building three long north and south lines, and thus far seem to have steered clear of financial snags. Florida lines have done little in comparison with last year's activity, when the State was at the head of the Southern list in its record of track laid. The Orange Belt, Florida Midland, and Plant System are doing the most work. Several large projects are noted, but their construction is rather doubtful.

The Central Railroad of Georgia is building and backing a large number of extensions in Alabama, as shown on the list. The extension of the Kansas City, Fort Scott & Gulf system to Birmingham, is one of the most important pieces of work of the year. Further extension to the Gulf or the Atlantic is as yet problematical. The long line of the Gulf & Ship Island through Mississippi, opens up the territory between the Illinois Central and the Mobile & Ohio roads, and seems to have a favorable prospect of completion. The Illinois Central appears to think that the traffic from Dakota wheat fields will prove more profitable than that from Mississippi cotton plantations, and has done nothing in Mississippi this year. A survey has been made, however, for a line from Jackson, Tenn., to Memphis, and one is now in progress from Cairo to Memphis, following the Mississippi Valley. One of the most extensive projects in the whole South is the Tennessee Midland & Virginia Western, which as originally proposed was to run from Memphis to the Atlantic Coast, about 800 miles. The failure to secure the expected half million dollars subsidy from Nashville may put a damper on the enterprise; but the prospects seem fair for completing the portion of the road in Tennessee at an early date. The Louisville & Nashville system, which last year did practically nothing in the way of extension, has this year displayed great enterprise. Including the Nashville, Chattanooga & St. Louis system, the record to date is track laid, 80 miles; in process of construction, 125 miles; surveys, 200 miles. One noticeable extension is its belt line about Birmingham. Its principal work for next year will probably be the Cumberland Gap extension, which is through very difficult country. The list of work in West Virginia and the greater part of Kentucky were published with the map of Oct. 8, and is therefore not repeated in our list, though the figures are included in the summary.

The general aspect of railroad building in the South, as shown by our map, is certainly very favorable. Visionary and wild cat projects are numerous, as in every section where enterprise is active; but most of the lines we describe have a solid basis, and are projected and built to furnish needed transportation facilities to regions whose natural resources are such as to sustain the roads when built. With favorable financial conditions there is good promise of profitable work in the South during the coming year for engineers, contractors and capitalists.

Some Needed Train Resistance Tests.

Not the least valuable result of the Burlington brake tests, perhaps, was the evidence which they afforded as to the resistance of entire freight trains, as summarized in the committee's report presented in our issue of June 25, 1887, and in part discussed at that time. In fact this evidence, merely "theoretical," as it may appear to some, had a direct bearing upon the purpose of the tests, for one of the main advantages—*the* main advantage in a money point of view—of introducing freight train brakes and good freight couplers will be that it will enable freight trains to be run at much higher speed where the grades favor it.

On thousands of miles in this country this will have the practical effect to add two or three cars to the average freight train, by the chance which it will give for "taking a run" at grades which are now a dead pull, especially after unnecessary crossing stops have been eliminated. How great a change is likely to result from these improvements in all the manners and customs of handling freight, and how great will be the resulting economy, is hardly yet appreciated. The practical effect will be to assimilate the construction of freight cars and the handling of freight train to the construction and the handling of passenger trains, in all but this respect: The speed on all long-up grades will be as slow as now, or even slower, but on down grades and on levels as close an approach to passenger speed as the freight engines permit (which is tolerably close) will be very common. This will on thousands of miles of road materially increase the limits of train length, including nearly all undulating roads. It will also eliminate a large part of the intolerable delay to freight trains which now result from the great difference in their speed from passenger speed and from their inferior strength, save many stops, decrease wear and tear greatly (which is only to a very trifling extent affected by speed as such) and thus in many ways increase economy of operation. That the cost of good brakes and good couplers will be repaid many times over in this way alone, after they are once introduced, we do not think admits of rational doubt.

Unfortunately, these advantages cannot be reaped until the use of both brakes and couplers has become quite general. Such changes must always be gradual, and as a chain is only equal to the strength of its weakest link, so the handling of freight trains must to a very considerable extent be adapted to the poorest cars in them. But there can be no doubt that a leading cause for the slow progress in this respect is the very mistaken idea that slow speed is economical and expedient in itself, and as to that, these resistance tests give very direct testimony so far as they go. More should be obtained.

Strange to say, they are about the only direct evidence of a trustworthy character as to the resistance of entire freight trains in

actual service; and certainly they are by much the most valuable and decisive. Dynamometer tests have the grave defect that they do not include the locomotive and head resistances, which are the most doubtful element of all, besides which, the dynamometer is something of a delusion as an instrument of precision. There are few of them which are really accurate at all times, the labor of computation is very considerable, corrections must be made for velocity and for the grade, and the exact weight of the train must be used. For all these reasons the results when they are obtained do not command nor deserve entire confidence for showing what is most needed, the *total* work done by the engine, and there are discrepancies in nearly all dynamometer work which we have examined which do not seem to admit of explanation as due to actual variation of resistance, but imply some error in the process; such, for example, as the results obtained in some empty and loaded train tests on the Chicago, Burlington & Quincy, where the empty cars showed a resistance per ton of about three times as much as the loaded cars, as the average of long trip. We all know now-a-days that empty car resistance per ton is higher than loaded car, but not in any such ratio as this, nor do they show any such absolute figures as 15 or 16 lbs. per ton, except for a minute or two in starting. Similarly, some dynamometer tests made some years ago at Cleveland, O., on trains of 1 to 6 cars showed the most erratic variations in resistance, which were plausibly explained as due to differences of condition of the cars, but the suspicious fact was that tests by the gravity method a year or two later, made over the same track at the same speeds with the same kind of cars selected in the same random way from the stock in the yard, showed no such erratic variations, but on the contrary showed a singular constancy of resistance, with limits of fluctuation of only about 1 lb. per ton each way instead of 6 to 10 lbs., and with something like a uniform ratio of increment with speed.

The dynamometer, therefore, while capable in many ways of valuable use, is always open to suspicion, and is not in any strict sense of the term an instrument of precision; besides which, the "work done" which it shows is not even approximately all that should be recorded, since it leaves out the engine, grade and rolling resistance and, at high speeds, the most dubious element of all, the engine head resistance. This induces a habit of mind in looking at train resistance which is always dangerous, and sometimes leads to absurd results, as in the "examples" of tractive power given in HASWELL'S "Pocket Book" (but not computed by him) where the engine grade resistance is left out altogether in computing what a Consolidation engine should draw up a grade.

On the other hand, the gravity method of test is absolute and positive at every step. A train of any number of cars or engines passes a point with a certain velocity, it rises or falls a certain number of feet, and then passes another point with a certain different velocity. The "velocity-head" due to the initial speed ± the fall or rise in feet will give what should be the terminal "velocity-head" *if there were no frictional resistance.* The difference between this and the actual velocity-head will give the frictional loss in vertical feet since passing the last point, and this ÷ the distance will give the resistance grade, which is at once converted into pounds per ton by multiplying by 20.

It is plain that if an error be made in determining the speed at an intermediate point, it will give the resistance on one side too high, and on the other as much too low, so that the average will be unaffected. In other words, having notes say for points 1,000 ft. apart, we can compute average resistances for stretches of any number of 1,000 ft. sections. Gravity, distance and elevations being constant and known precisely, the only possible source of error is the determination of the speed, which can be determined very minutely, and simply by electrical aid, without any dynamometer car. The computations are simplicity itself. Hence the results may be accepted with absolute confidence as true for the trains tested, and as the resistance may be computed for each successive 1,000 or 5,000 ft. for any number of successive differences, there is a further check on the results.*

This being so, no common interest attaches to the fact that the tests of both years seem to clearly show that the resistance of entire freight trains in service does not appreciably increase with speed up to a limit of 25 miles per hour, and is increased very slowly (as the committee do not state explicitly) up to 30 or 35 miles per hour. In last year's tests the Westinghouse train showed only 4 lbs. per ton at 15 to 20 miles per hour, and only 6 lbs. per ton at 35 miles per hour. The other tests showed higher absolute resistances (6½ and 8½ lbs.) but an even less increase of resistance at 30 miles per hour (to about 8½ lbs. in each case). This year's tests, after deducting 0.9 lbs. for the resistance of the curves (which averaged 1½°) ranged as follows:

	Speed.	Resist.	Speed.	Resist.
Westinghouse,	15	5.87	23¼	7.82
Carpenter,	15	6.22	22¼	8.19
Eames,	14¼	7.51	20	10.10
	14¼	6.33	21.7	8.70
Difference,			7.0	2.37

These figures on their face show a somewhat greater effect of speed than last year, but it is to be remembered that in each case they give only the average of a long run at constantly varying speed, and hence do not cover as wide a range of speed as the tests actually had. The full range of speed and resistance, if shown, would undoubtedly correspond still more closely with last year's results.

So far, this is well, but there is an obvious lack in the scope of these results which ought to be supplied, and which it is a leading purpose of this article to point out, in the hope that it will be supplied. If it were a mere question of scientific curiosity this hope might be a vain one, although "scientific curiosity," with no other end than its own gratification in immediate view, has led to some very important results heretofore. But as direct and immediate financial questions are involved, which are even now important, and must every day become more so with the more general use of better brakes and couplers, there is more reasonable ground for hope.

The "obvious lack" referred to is this: These tests all stop at what are even now common rates of freight speed, 20 to 30 miles per hour. But it is highly dangerous to draw conclusions from even the most trustworthy tests which do not extend considerably beyond the range of the conclusions. In order to know with certainty the relative resistances at 15, 20, 25 and 30 miles per hour we must have tests running up to 40 or 50 miles per hour. Again, maximum freight speeds of fully 40 miles per hour in sags and similar places will be imperatively demanded for operating economy as soon as we have freight brakes and couplers to make such speed safe. As to the actual resistances (and hence relative wear and tear) at such speeds we have absolutely no information, although there is a great deal of calmly assumed misinformation floating around the country, as an inheritance from the appliances and methods of a past generation. Again, what is the relative wear and tear of freight and passenger cars at high speeds; in other words, how much is lost in smoothness of motion by the rough springs and rough construction generally of freight car trucks? We do not know, and trustworthy tests of comparative *resistance* would shed a vast deal of light on this point also. Again, what is the comparative and absolute resistance of passenger trains at 30, 40, 50 and 60 miles an hour, and how much does it add to add more cars at the rear? There is no man living who can now do more than make a wild guess at this. We can all guess, and there is considerable fragmentary information to be had which may (or may not) help to a right guess, but no man *knows.* We should except some possible German or Frenchman, for we well know that they have tried to do not a little work in this line, but most of their reported results are open to suspicion. The most elaborate tests ever made on train resistance, some very extensive German tests reported by the eminent Baron VON WEBER, led to the valuable result that train resistance was a function of v^3 instead of the usually assumed v^2, and hence that at less than 40 miles per hour a locomotive would have all it could do to move itself! This interesting conclusion was gravely and formally announced, and resulted merely from a too rigorous application of the "method of least squares" to the analysis of tests not so distributed as to safely admit of its use, as we pointed out at the time. Mathematically, it makes no difference whether a base line be an eighth of an inch long or a thousand miles; it can be prolonged into the farthest heavens with equal exactitude, but it is not exactly so in practice—a truth which the Continental investigator so often fails to grasp in its entirety as to make it weary work separating their wheat from their chaff. With English and American investigations it is much easier, because there is nothing which can even be claimed to be wheat.

What is lacking then seems to be this, and it might be so easily obtained that we cannot but hope some one will try to get it:

1. *Trustworthy* evidence, obtained by the gravity method, of the resistance of entire freight trains, empty and loaded, engine and all, at 30 to 50 miles per hour, for at least two different lengths of trains, say 25 and 50 cars, or 40 and 20, or 15 and 30.

2. Similar evidence of the resistance of entire passenger trains at 40 to 60 or more miles per hour, for at least two different length of trains, say 6 and 12 cars, or preferably 4, 8 and 12 cars, using if possible the same engine as for the freight tests.

These tests should preferably all be made on a straight line, on good average track, and on a sharp down grade. The only necessity is to know the actual elevations of rail at 1,000 ft. or more intervals upon 3 to 5 miles of track, to have no very violent changes of grade between, to determine the rate of speed accurately when the *center of gravity* of the train passes the initial point and each intermediate, to take from a table for each speed the equivalent "velocity head," and then compute the resistance as heretofore outlined.

Such a series of tests would only take a few days, and cost only the use of the cars and engine for that time, they are very readily computed, they have no single necessary element of possible error, and they would give more trustworthy, and hence more valuable evidence than can be abstracted from all the dynamometer tests which have been made

*The manner of computing tests, and the actual results of the Burlington tests of 1886 are more fully shown by diagrams and tables on p. 496.9 of "The Economic Theory of the Location of Railways" by A. M. WELLINGTON, C. E. It appeared from the report given June 25 that the 1886 and 1887 tests gave almost identical results.

from the beginning of railroading until now. In fact, they would be our only really weighty evidence. We cannot but hope that some one will make them.

Army and Civil Engineers.

A correspondent in another column starts up anew this unending question, and with a certain bitterness which we regret to see, not because there are not some grounds for such bitterness, but because the army engineers did not create the situation, and the question is not so entirely one-sided as our correspondent implies. There are a great many able engineers, abundantly competent for their positions, in the government service, and there are a great many more who are in every way agreeable men to serve with and under, as in fact, by general admission, the majority of them are.

Again, for a large part of the follies in river and harbor work the engineer officers are in no way to blame. One of the corps has commented on this very matter lately in the *Evening Post*, commenting bitterly on the absurdities into which the engineer corps was forced by the folly of Congress. He mentions a number of instances in which the stream which the law ordered "improved" could not even be found, among which were the famous Clark's creek and Mingo creek in South Carolina, which we have long since described but which will bear repetition. These creeks had $75,000 allotted to them. The article says:

> Lieut. ABBOTT went down to make the survey: but no one had ever heard of "Clark" or "Mingo"; they were not down on the Department maps; however, ABBOTT began a search among the creeks and inlets of the coast. He spent several weeks in that labyrinth, questioning negroes and whites without result, and at last in despair wrote to Congressmen AIKEN of the Third District asking him if he would be so kind as to let him know definitely where the creeks referred to in the Act would be found. Mr. AIKEN sent the letter to the Charleston *News and Courier* with these comments:
>
> "Since I first entered Congress, year after year I reluctantly voted for the River and Harbor Bills as presented from the Committee for approval by the House, not because I disapproved reasonable appropriations for the improvement of our harbors and national streams, but simply because annually there was a Mingo Creek or some such other 'nigger in the woodpile' in every one of them, that would shovel money into some private individual's pocket, as I believed, rather than deepen the bed of a stream that floated our products to the sea. But I think the enclosed letter presents a case that does not belong to the Third District, and was certainly never presented by me, for I do not remember ever having asked a dollar of appropriation for this or any other creek, and therefore I suggest that the engineer must go probing about in some other section of the State less hilly than the Third District before he will find his Mingo creek, or quite as likely his Clark's Creek, 'into whose dry bed water must be dipped from elsewhere to establish a commercial stream.'" The *Courier*, with the maps of the State at command, could not find the desired creeks and said: "It is strange that the United States Government should be asked to give money for the improvement of streams which are so unimportant that the United States Engineer has to organize a searching party in order to be able to find them."

A similar case was a Falmouth "harbor of refuge;" and a number of other scandalous cases are narrated, where the "rivers" have turned out to be 2 or 3 ft. deep with no commerce whatever. Cases like the Wareham river and harbor in Massachusetts, the Pawtuxet and Potowomut rivers in Rhode Island are also mentioned, where one or two persons only worked through the appropriations for their private benefit, and where there was no possibility of general commerce even with the smallest craft. On the other hand, the great harbor of New York is alleged to have only had spent upon it, from the beginning of River and Harbor bills to now, $3,003,280; Philadelphia and the whole Delaware river, $2,903,552; Boston, $1,516,663, and Baltimore, $1,171,830. Thus the engineer officers are hampered in two ways, by too much and too little appropriations, and their engineering skill cannot but suffer reproach therefrom, which in many cases is unjust.

But that the present system is radically wrong and demands correction is beyond reasonable denial. It denies to the young army officer those years of subordinate *practical* service—drafting, running instruments, sounding, and what not—which alone makes a man a thoroughly sound engineer. Etiquette does not permit him to serve under a civilian, nor, we may add, perform subordinate routine work of any kind. On the other hand, the young civilian, who has had for the most part as good a technical education as the West Pointer to begin with, if not a better one, goes for some years through precisely the kind of drill which a young fellow ought to have to rise to the top later. He gets good pay for his age, and is well off, and becomes trained to this work and no other. Then begins the iniquity. His path to promotion is choked impassably by those who have *not* had as good training to warrant it as he. He must get small pay, so as not to exceed the nominal rate of army officers above him, which is really far higher than it appears from its being a life position, sick or well, with retiring pay, pensions and like perquisites. He is caught as it were in a professional trap. He can neither go forward nor back. He grows more and more skilled really, and hence is intrusted with more and more responsible duties, but he must continue a sub to those whom he is every day advancing more and more beyond in skill. In practice the system works far better than this dark but true picture would seem to make possible, but it works badly and inequitably enough, and should certainly be changed.

The true reform would be to copy the Prussian system, which we have often described; to organize a civil corps for civil works, and leave the military engineers to do *all* the work for the military works, which, if we kept our coast defenses in the condition they should be, would be quite enough to keep them all busy. If not, they should be detailed on equal terms to the civil service. Prussia is divided into districts, with a chief engineer at the head of each and residents under him, each with assistants, and the whole under a Minister of Public Works (a new cabinet officer which should certainly be created in this country) instead of the Secretary of War. This force prepares all plans and estimates, and it is an unwritten law that only in extreme cases shall they be gone beyond. The system works perfectly smoothly, and there is no thought of mixing up these matters with military control. If this is the case in so military a country as Prussia, it is absurd that in peaceful America we should perpetuate so contrary and so unjust a system. Nor would it be thought of except that it is a survival from early days and from small beginnings, when there seemed no other convenient way. Our system should be reformed, and all engineers should do what they can to spread the knowledge that reform is needed.

CORRESPONDENCE.

The Wagner Steamed Filter Well System at Hamilton, O.

HAMILTON, O., Nov. 23, 1887.

EDITOR ENGINEERING NEWS:

The water supply procured for this city by the National Water Supply Co., of Cincinnati, is by means of a system of 20 Wagner steamed filter wells, 40 to 50 ft. in depth and flowing through 6-in. tubes into a suitably graded main of hub end standard cast-iron pipe ranging from 8 ins. to 30 ins. All these filter wells are purely artesian in effect, and pour their respective supplies through the main into a large walled well under the pump-house, which is about 700 ft. from the filter wells. The supply contracted for was 3,000,000 galls. per day of 24 hours, but the quantity actually procured must be at least 4,000,000 galls. Some 3,250,000 galls. per day of 24 hours were pumped with perfect ease during the test made, and the manager of the National Water Supply Co. seemed to feel perfectly confident (and for evidently good reasons) that over 4,000,000 galls. could be pumped with equal ease. Yet this is the dryest season ever known in this section of country, and most farm and other wells are exhausted, and even the river is nearly so. The water from these steamed wells is as clear, soft, cold and pure as can be desired, and very slightly impregnated with iron. The medical faculty speak of it in highest terms.

These wells were excavated by the direct application of a strong jet of steam to the earth removed, and all sand, silt, clay and fine gravel blown out as by volcanic action from a depth of 30 to 50 and more feet, and a diameter of 12 to 15 ft., and a 6-in. tube made to follow the steam pipe to near the bottom in each instance. That produced a large reservoir consisting of the open spaces among the coarse gravel for a diameter, respectively, of 20 and 15 ft., surrounded by a filter wall of natural earth 36 to 45 ft. in circumference, for the supply to filter through into each well before reaching the 6-in. tube that conducts the water to the main. The artesian effect seems much enhanced in each case by this large filter capacity, and the water rushes up as clear as glass. This, it will be noticed is, in a sense, the old filter gallery system in an improved form; and one of the marked improvements is, that these filter wells can be steamed out afresh at any time it may become desirable to do so, whereas the ordinary gallery, when it once becomes compacted, is of no further use.

In this system the filter reservoirs are so thoroughly and extensively cleansed that no screens whatever are used at the bottom end of the tubes, and yet not a particle of sand or other matter rises, despite the strong upward rush of water.

These wells are excavated in the bed of the old supply basin. The main conducting the new supply is the same that brought the old from the basin by gravity flow. The two pumps have a capacity of 3,000,000 galls, and were built by the Gordon-Maxwell Co. of this city. The supply may be delivered directly to consumers, but is usually forced to a surface reservoir on the opposite side of the river from the pump-house and overlooking the city. The new supply seems to be as complete a success as can be desired, and is said to be the nineteenth already procured by this steam excavating process. The working outfit that did this job was ordered from here to Memphis, Tenn., to procure a 12,000,000 galls. supply for that city.

Our water works trustees are to be congratulated on the success of their selection of a system of supply, and for the favorable contract obtained. The National Water Supply Co. also has performed its part of the contract in a most creditable and liberal manner, which cannot fail to insure to its benefit in competing for similar work elsewhere.

A.

Locomotive Coal Consumption as Affected by Temperature.

Lehigh University.
BETHLEHEM, Pa., Nov. 28, 1887.

EDITOR ENGINEERING NEWS:

The articles on "Operating Expenses" and "Train Resistances" in the revised edition of Mr. WELLINGTON'S "Economic Theory of Railway Location," have been very helpful to me in the discussion of some locomotive tests made last summer on the Lehigh Valley R. R. I am still engaged in working up the result, and would like to reduce all experiments to the same temperature. On page 137 of that work I find a simple rule which I would like to use for this purpose, as it would explain variations that I cannot account for satisfactorily in any other way. The rule referred to is:

> "The correction for temperature is by a rule deduced by the writer from records covering many millions of train-miles, that *the effect of differences of temperature alone, length of train and all other conditions being equal, is to increase or diminish coal consumption at the rate of* ONE *per cent. for each* TWO *degrees Fahrenheit* (and a small fraction more) *difference of external temperature*: a rule easily remembered and one which appears to apply fairly well to both passenger and freight service,

and to be practically invariable whenever the effect of all other causes for variation can be e imated."

But I've one, only one, experiment which stands in the way of accepting this rule, and which I will now detail. The locomotive had its fire drawn (at Perth Amboy, N. J.), the top of the smoke stack closed so as to prevent cooling currents from passing through the tubes, and the rods taken down so as to prevent all pumping action of valves. It was then hooked behind a train of ten gondolas and drawn 60 miles (to Easton, Pa.) with only one stop, the average speed whilst running (before and after stop) was about 39 miles per hour. A record was kept of time gauge pressure and mile posts. The gauge had been carefully compared with four new and well made Crosby Indicators under same conditions.

The pressure fell uniformly, and when plotted over a time base gave a curve that was very nearly a straight line. Dividing the experiments into two parts (before and after stop). I deduced the following *empirical* rule: $H = 0.052\ D\ T^{2.1}$ when H = units of heat lost, D = distance traveled in miles; T = average difference of temperature of steam and air in Fahrenheit degrees.

Weight of *naked* boiler of same size was found to be 21,000 lbs. From the observed position of water in *front* and *back* glass gauges the water in boiler was computed to be 10,000 lbs. The specific heat of the iron was taken at $\frac{1}{3}$th. The water part of boiler was 262 ins. long, and shell was 54 ins. in diameter.

The experiment was made Aug. 15, and temperature of air was 70° from 2:15 P. M. to 4:01 P. M. The corrected gauge pressure of the two sections of the experiments taken were:

I	II
113 lbs. 345.7° F 92 lbs. 332.3° F D=25.3 mls	86.95 lbs. 328.76° F 73.3 lbs. 318.45° F D=23mls.
time = 2 32-15 / 8-09-30 P.M.	time = 3-20 20 / 3-56 16 P.M.

During the experiment, the speed ranged from 32 to 52 miles per hour. The formula gives very accurately the heat lost during those two sections. Of course, it is empirical, and not applicable except in the neighborhood of the conditions for which it was established. For $D = 0$ it evidently fails, and for this case I have taken another empirical formula also based on only one short experiment of 9 minutes, viz.: $H = 25 \times t \times T$, when H = heat units lost while standing still; T = difference of temperature of steam and air; t = minute that engine was standing still.

Now I fully appreciate how inadequate such a slender basis of experiment is, and hope you can favor me with references or records that will enable me to count for temperature while engine is standing or running on the road.

The experiment whilst running was carefully made, but its results differ so widely from that given by the rule above quoted from, p. 137, that I would be glad have you point out wherein my error if any, lies. Yours truly, J. F. KLEIN.

[WE are compelled to postpone to another issue an answer to our correspondent's questions. The supposed discrepancy is imaginary. —ED. ENG. NEWS.]

Army and Civil Engineers.

EDITOR ENGINEERING NEWS:

At the convention of the American Society of Civil Engineers held at St. Louis in 1880, an attempt was made to inaugurate a reform in the system of public improvements as then directed by the U. S. Engineer Corps. After considerable discussion the matter was referred to a committee of the society where, from obvious reasons, the movement came to an untimely end.

In 1885 the subject was again agitated, and a general interest awakened throughout the country, unanimous opinion being that some change in the system was greatly needed. A convention of delegates from a majority of the engineering societies of the country was held at Cleveland, and the incongruities of the present system of internal improvements pretty thoroughly discussed.

The subject was finally referred to a committee to collect further information and devise ways and means of bringing it to the attention of Congress.

As nothing has been heard in regard to the matter of late the question naturally arises: What has become of the committee and their reports? The subject is one worthy the attention of every civil engineer, and a careful consideration of the present methods can lead to but two conclusions, either a complete reorganization of the whole system is necessary, or else the engineer corps should be obliged to reform the abuses which have crept into its methods of conducting work.

When we consider the practical experience of the average engineer officer, after graduating from West Point, it is not surprising that decaying monuments of their visionary schemes are to be found on nearly every coast.

Soon after graduating from West Point the young Lieutenant of Engineers is usually ordered in charge of some improvement work where he struggles through the laborious task of signing checks in payment of labor executed under some civilian assistant, and modestly allows himself to be given the credit if the work is a success, or permits his assistant to take the blame if it is a failure.

Three years of this kind of experience is the average time allowed by the corps for a young officer to absorb what information he can on the work in question, and then he is transferred to some other department of the great public engineering school.

A few years later, when through the death of some senior officer, the young West Pointer has been correspondingly advanced in pay and rank, we find him a member of various engineer boards, gravely discussing the most important improvement problems of the day to the exclusion of eminent civil experts who have grown gray in the study of their specialties.

The engineer in devising any system of improvement must be practically familiar with the probable effects of all the forces that are liable to be brought into action by the work to insure success. The study of engineering, however, is becoming so vast that this can be the case only where the work is under the direction of one who has made a special study of that particular branch of engineering. The engineer officer's knowledge is supposed to take in the whole domain of engineering, both military and civil, and consequently what other results could be expected then those to be seen on every hand?

Out of this superficial state of affairs a system of abuses has arisen which one would suppose the corps would have sufficient honor to reform of its own accord. The worst of these is the practice of officers taking the credit of work designed and executed by civil assistants under their orders, and, in some extreme cases, totally ignoring the individual to whose ability the whole success of the work was due.

In order that the pay of the civil assistant may not too much exceed that of the young West Pointer in charge, a sort of unwritten law has been established by the corps that no civilian shall receive more than $3,000 salary per annum. And to enforce this law, corps etiquette will not allow one officer to offer any position to a civilian under the orders of another officer without the consent of the latter, which consent is as a rule withheld.

Another abuse in the system is of such a humiliating nature that engineers in the service hesitate to mention it. Of the whole number of officers in the corps only a small percentage condescend to recognize their civil assistants as social equals. Not that the civil engineer craves their society, but that often being the intellectual and moral superior of the officer the civil engineer is certainly entitled to recognition as an equal. Four years of education at government expense, together with the exclusive privilege of signing all checks for the disbursement of the vast appropriations for rivers and harbors, seems to have given rise to a feeling of caste in the corps which is repugnant to all recognized ideas of what American institutions should be.

The question is often asked why the civil engineer, if so dissatisfied, remains in the service. But after having spent fifteen to twenty of the best years of his life in reaching the limit of advancement in some special branch of work is it strange that he should hesitate to commence back at the beginning in some other department of the profession, well knowing that old age would probably overtake him before he could reach eminence in his new calling?

The result is that the plans and estimates for systems of internal improvements made under the direction of engineer officers, whether of utility, or not, are almost invariably approved by the engineer boards to which they are referred. Citizens in the locality of the work do not care to complain for fear of loss of future appropriations, and the civil assistant in charge, although he may be aware of the worthless character of the plans, cannot protest if he cares to retain his position.

The fallacies of a few of the more important schemes of the engineer corps have been exposed by the late Captain EADS and others, but the investigator will have no trouble in locating scores of others if he will take the pains to look the matter up.

The boast of the engineer corps is that it has expended the vast appropriations entrusted to its care without loss from defalcation. This, however, seems a sort of negative virtue when we consider the vast sums that have been wastefully applied, and that the restrictions on disbursements are such that only petty stealing is possible. It is, however, due to some of the best officers of the corps to state that they would gladly welcome a reorganization if started in proper shape.

It is to be hoped that the committee of engineering societies having this matter under consideration will make a thorough and systematic report, and that some plan of reorganization will be devised and adopted by which the important positions on public works may be filled by the best qualified individuals without regard to whether they come from military or civil life.

ENGINEER.

Idaho Irrigation Schemes.

Important to Contractors.

ALBION, CASSIA CO., IDAHO, Nov. 25, 1887.

EDITOR ENGINEERING NEWS:

Enclosed find newspaper slip in explanation of this letter. I will send you a copy of the holiday issue of the Cassia County *Times*, in which a history of the enterprise will be given. Our territory has been somewhat backward, although steadily improving. In order to hasten this development, the citizens of the county clubbed together for a reconnoissance of the country, which has just been completed, although means were very limited, still the results have been most satisfactory; as soon as possible we want to lay the matter before capital inviting investment. This work has all been done to show up the resources of the country. There is no speculation in it only as all will expect to benefit by the general development.

This is a gigantic enterprise, but still one that can be carried through for comparatively small expense, as shown in the article, and will then pay large interest on the investment. Investments in irrigating canals are the most remunerative, safest and surest of all investments, and the field is open.

In order to make an estimate of cost I would like to have some information about the most improved machinery, and its performance in "moving large quantities of dirt," at what cost per cubic yard for different depths and widths, etc. How is it with steam excavators and dredges? In this country horse machines work very well for narrow canals. I do not know who to write to and as I want this information as soon as I can get it, will you please give it to me? Very respectfully yours,

FRANK RIBLETT,
County Surveyor.

P. S.—Water rents by the season for from 50 cts. to $1.00 per acre in the West; the cost of maintenance should not be large. We invite correspondence with capitalists, persons desiring to emigrate, and all persons interested in the Great West.

Many placer mines could be worked with water furnished from this canal that otherwise would be forever useless, thereby furnishing a large additional revenue from all along Snake river—R.

[This description is unavoidably left over till next week.]

Plate Girder Draw Bridge.

PITTSBURG, PA., Nov. 24, 1887.

EDITOR ENGINEERING NEWS:

In your last issue, under the head of "Connecticut Association of Civil Engineers and Surveyors," you mention the Asylum street draw-bridge as the largest plate girder draw-bridge in the country. This is certainly not the longest plate-girder draw-bridge in the country, as the Keystone Bridge Company has built at least three that exceed it in length, viz: one

of 90 ft. for the Southern Pacific Railway, one of 190 ft. for the Richmond & Danville R. R., and one of 190.6 ft. for the Pennsylvania R. R. Co.

Yours very truly

FRANK C. OSBORN.

[We believe the bridge at Hartford, Conn., is the largest *highway* plate girder drawbridge. —ED-]

PERSONAL.

JAMES A. SIMMONS, of New York, is President of the U. S. Improvement & Construction Co.

BURR BASSELL, of Los Angeles, Cal., has been appointed Chief Engineer of the Semi-Tropic Land & Water Co.

WALTER G. PHELPS, C. E., who died at Bridgeport, Conn., Nov. 18, was for several years with the Chicago, Burlington & Quincy R. R.

WM. A. GARDNER has been appointed Superintendent of the Chicago, Milwaukee & Eastern division of the Wisconsin Central R. R., to succeed F. A. MERRILL, resigned.

DONALD ALLEN, Division Superintendent of the Houston & Texas Central R. R., at Waco, Tex., has accepted a position on the Louisville & Nashville R. R. as Superintendent of the division between Decatur and Mobile, Ala., with headquarters at Birmingham. He will be succeeded by J. M. LEE.

W. J. SPICER, General Manager of the Chicago & Grand Trunk and Detroit, Grand Haven & Milwaukee railroads, is to resign his position to take the General Managership of the new Duluth, South Shore & Atlantic road.

Gen. ZENAS C. PRIEST, died Dec. 4 at Little Falls, N. Y. He was Division Superintendent on the N. Y. Central for many years, having commenced his railroad experience in 1835 He was born in April, 1806

MARIE FRANCOIS SADI-CARNOT, the newly elected President of the French Republic, is a civil engineer. He graduated from the Polytechnic School, and was engineer in charge at Annecy. In 1871 he was made Prefect of the Lower Seine. He soon after went into public life, was Under-Secretary of Public Works in 1878 and in 1880 was Minister of Public Works. He is 50 years of age.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The regular monthly meeting was held on Dec. 7. The only business transacted was the canvass of the ballots and the passage of the resolution reported by the Committee on Membership Grades, fixing the dues of the proposed Student Grade, if created, as $6 for non-residents, and $10 for residents.

The paper of the evening was a highly interesting and important one by Mr. WILLIAM METCALF, of Pittsburg, Pa., closing the discussion of his original paper on "Steel," which all our readers will remember. As we shall publish hereafter a full summary of this paper we will not now attempt to make one. Beginning with an expression of regret that the discussion should have been so largely confined to the gun question instead of the general one of steel, and remarking that, having expressed his views, he would leave every one to form their own opinion and retain his own, Mr. METCALF proceeded to a highly interesting discussion of the general nature of steel, and especially of tempering and annealing, which was listened to with great interest and loudly applauded at the close.

The Secretary then read some data on the "Protection of Piles from *Limnoria* and *Teredo* in San Francisco Bay," presented by MARSDEN MANSON, M.A.S.C.E., Chief Engineer of the Harbor Commission, San Francisco, being his final report to the Commission on the teredo experiments recently conducted. In June, 1882, 99 piles prepared by various methods were driven, and after an exposure of 5 years, 4 months, some of each method were removed and also some unprepared or naturally bark protected piles. Mr. MANSON summed up "that the coatings applied by the various experimenters, depending upon their adhesion to the pile, utterly failed to afford even the protection given by bark. This has been the history of such experiments in other places. Of the 8 coated piles removed, belonging to the Shay, McKeon, Pearse & Beardsley and Raye methods, but one retained sufficient strength to permit its removal, and this one was more severely attacked and damaged than any of the 4 'unprotected' piles pulled up, or the cedar piles." Cedar piles were practically uninjured; eucalyptus piles were all severely injured, and yellow fir piles were all slightly damaged, but none so much so as to be weakened. The matter was discussed by Messrs. Collingwood, Thompson, Flagg and others.

A portion of a palmetto pile, from Charleston, S. C. was exhibited; the interior was entirely disintegrated, the fibres being all separated; this was a practical contradiction of a statement that was made some time ago that the teredo would not attack the palmetto. A portion of a New York pile, thoroughly honeycombed, was also exhibited.

The following candidates were found elected.

FOR MEMBERS.

TUCKER C. EGGLESTON, formerly on Richmond & Alleghany R. R.; Eastern Extension Chesapeake & Ohio R. R.; in charge cross section party Atlantic & N. W. R. R.; in charge topographical survey and location narrow gauge R. R. at Natural Bridge, Va.; recently Asst. Engr. and now Resident Engr. of Maint. of Way Richmond & Alleghany R. R., Richmond, Va.

CHARLES E. NEWHAM, formerly on New York Elevated R. R.: Asst. Engr. Imp'ts. at Harsimus Cove; Asst. Engr. New York Div. Penna. R. R.: Rest. Engr. N. Y., Lacka. & W. R. R.; Asst. Engr. to New Jersey B'd of Assessors; Div. Engr. Atlantic Coast. St. J. & Indian River R. R.; now First Asst. and Loc. Engr. Vincennes & New Albany R. R. Vincennes, Ind.

HENRY B. SEAMAN, (Swarthmore Col. 1881.) (Elected Junior June 2, 1886.) formerly engaged with Engineer Corps N. Y. Lake Erie & W. Coal & R. R. Co.; Asst. Engr. Rochester & Pittsb. R. R.; Bridge Dept. of Wilson Bros. & Co., Phila., Pa.; Bridge Dept. Edge Moor Iron Co.; Asst. and afterwards Div. Engr. in charge Superstructure Kings Co. Elevated Ry.; now Prin. Asst. Engr. with Wilson Bros. & Co. Phila. Pa.

FOR JUNIORS.

WILLIAM P. FIELD, (John C. Green School of Sci. College of N. J. 1883.) formerly engaged in office of Engr. Maint. Way Penna. R. R; now Asst. Supervisor Div. A. N. Y. Div. Penna. R. R. Newark, N. J.

ROBERT V. A. NORRIS, (School of Mines Columbia Coll. 1885.) Asst. Engr. Susque. Coal Co. Wilkesbarre, Pa.

LATEST CHANGES OF ADDRESSES, AMERICAN SOCIETY OF CIVIL ENGINEERS.

JOHN W. BACON, Danbury, Conn.

WILSON CROSBY, 125 Hammond street, Bangor, Me.

EDWIN DUBYEA, Jr., Engineers' Office Cairo Bridge, Cairo, Ill.

JULIUS E. HILGARD, 1204 Massachusetts avenue, Washington, D. C.

GEORGE H. PEGRAM, 18 Broadway, New York City.

YOSHICHIKA WADA (Care J. A. L. Waddell), 118 West Sixth street, Kansas City, Mo.

JOSEPH WOOD, General Superintendent Transportation, Pennsylvania Co., Pittsburg, Pa.

The Treasurer of the American Society of Civil Engineers, will shortly issue a circular asking for remittance of the subscription made to the Building Fund. The Board of Direction consider it desirable to collect before the end of the fiscal year, all unpaid subscriptions so that the annual financial statement may include all assets of the Society and show the receipt and disposition as far as possible of all available funds. Of the $9,069.50 subscribed up to date, $2,809.50 have been paid.

Some of the papers to be read during the coming winter before the American Society of Civil Engineers, will be one on the "Panama Canal," by Lieut. CHARLES C. ROGERS, U. S. N., and one by CLEMENS HERSCHEL, M. Am. Soc. C. E., on "The Venturi Water Meter."

The New England Railroad Club will hold its regular monthly meeting on Dec. 15 at its rooms in the Boston and Albany Station in Boston, Mass. The subject for discussion will be "Continuous Brakes for Freight Trains." FRANCIS M. CURTIS is the Secretary and Treasurer.

American Institute.—Prof. P. H. VANDER WEYDE will lecture in Clinton Hall, Astor Place, New York, on Thursday, Dec. 14, at 8 p. m., before the Polytechnic Section, on "The New Chemistry." The lecture will be profusely illustrated by diagrams and the projecting lantern. The public is invited.

New England Water-Works Association.—The regular quarterly meeting will be held at Young's Hotel, Boston, Mass., Wednesday, Dec. 14. Prof. DROWN of the Massachusetts Institute of Technology, will read a paper entitled "The Odor and Color of Surface Waters.' EDWIN DARLING is President, and R. C. P. COGGESHALL, Secretary.

(*Continued from page 403.*)

American Society of Mechanical Engineers'. Meeting at Philadelphia.—At the fourth session, Wednesday A. M., Nov. 30, Prof. GAETANO LANZA, of Boston, read a paper on "Friction in Toothed Gearing." Starting with all necessary assumptions, the object of this paper was to deduce mathematically the correct solution by which other approximate solutions can be compared.

Prof. WEBB considered that the fundamental part of this demonstration was in Canon MOSELEY'S book. It is no fault that such work is approximate, nine-tenths of our practical work is only approximate. He showed a sketch of a dynamometer for measuring the friction, and comparing involute with epicycloidal teeth.

Mr. BILGRAM demonstrated that when only one pair of teeth are in contact at a time, with epicycloidal teeth, the tendency to wear is uniform on each side the pitch point, and with the involute teeth the wear and loss by friction is distributed, being nothing at the pitch point and increasing each way to end and root of tooth.

Mr. W. LEWIS said that Prof. LANZA'S assumption that the moment of resistance was constant was no more true than that the driving moment should be assumed as constant Other assumptions should be made. He proposed to split the difference by considering a wheel driving a rack by a constant force. It was concluded that experimental tests are necessary to determine the relative value of different teeth, the theoretical differences being so small.

The next paper, read by Prof. LANZA, was by Mr. JEROME SONDERICKER, of Boston, on "An Investigation as to How to Test the Strength of Cements," which we shall note more fully later.

Mr. PARSONS said that pressures on cement must be put on gradually. During testing the pressure must not be stopped for an instant. Cements in zinc troughs set up a chemical action which affects the cement. Cements should be left in molds at least 24 hours, covered with a damp cloth. If these precautions are taken, the results obtained are very accurate.

The next paper was by H. DE B. PARSONS, of New York, on "The Influence of Sugar upon Cement," and gave results of experiments by H. H. PORTER. The utility of the improvement is restricted, it is used in restoring fractures in building stone.

Prof. DENTON said the tensile strength of the cement is about the same with or without the addition of sugar.

The next paper (XIII.) was by Mr. JOHN COFFIN, of Johnstown, Pa., on "Steel Car Axles." [See paper. The Pennsylvania R. R. requires the test to be 5 blows at 25 ft., of a 1,640 lb. weight, striking midway between supports 3 ft. apart; axle to be turned over after each blow. This is on steel axles 4⅜ ins. in diameter.

Mr. HEWITT thought that this remarkable material, viz., mild steel, is rapidly taking the place of wrought-iron in every direction. Results in St. Petersburg showed a great variety in structure, according to the temperature used.

Mr. E. C. FELTON, of Steelton, Pa., next read some "Notes on Results obtained from Steel tested shortly after Rolling." His conclusion was that the tests made upon the ¾-in. round bars seemed to prove that after rolling, steel increases in percentage of reduction of area, in percentage of elongation, and in ultimate strength, and decreases in elastic limit. "I have endeavored to account for these changes by supposing that the rough mechanical treatment of the metal by the rolls had temporarily weakened the hold of its molecules upon each other, and that this hold is regained when the metal is allowed to rest."

Mr. LEWIS F. LYNE, of Jersey City, next read a paper on "The Use of Kerosene Oil in Steam Boilers," for the prevention of scale. No information on this subject appears to be had from books. He has found such use to be advantageous, and has as yet found no objections in his experience.

At the concluding session in the afternoon, the next paper taken up was one by Mr. JAMES M. DODGE, of Philadelphia, on "A New Method of Stocking and Reloading Coal" (which we shall report more fully) in which he recommended the use of the flying extension. He said "the average cost of stocking coal on either side of a trestle to a distance of, say 20 ft., is about 30 cts. per ton, whereas the cost for stocking coal with the flying extension is but a fraction of this amount. There are four of these conveyors now in use at the wharves of the Philadelphia & Reading Railroad Co. at Port Richmond, Phila., and others in process of erection. By means of the flying extension, and reloading conveyors, it is possible to store immense quantities of coal on vacant land at some distance from the sea coast, and cheaply reload it, and deliver it at tide water till called for, instead of storing coal under expensive trestle work, and upon valuable dock property."

A paper on "A Railroad Bed for Bridge Structures," by Mr. O. C. WOOLSON, of Newark, was next read. It related to a flexible wooden support, especially for an elevated structure like the New York Elevated road. He said in conclusion that with a flexible road bed, as designed, there would be a very large saving in maintenance of bridge structures, and also a higher rate of speed could be allowed, with less injury to both bridge and rolling stock than with any system which he had yet seen.

Mr. C. E. EMERY showed an interesting indicator diagram from a U. S. Revenue Steamer.

The concluding paper (the twentieth) was by Mr. FRANK H. BALL, of Erie, Pa., on "An Improved Form of Shaft Governor." Steam engine governors have from the earliest forms down to the latest production employed centrifugal force in every successful design almost without an exception. The exception has been

in the direction of fluid governors; but as these require greater power to drive them while the variations of speed they allow are as great as with centrifugal governors, practical use has given an unfavorable verdict in regard to them. The writer in 1878 conceived the idea of constructing a centrifugal governor on the shaft of the engine and so arranged that the driving pulley, instead of being keyed to the shaft, is driven by the governor in such a manner that the load is made to act as centrifugal force. With this arrangement the governor may be adjusted for ample stability, and the effort of the load adjusted to exactly correct the change of speed that otherwise would take place, and this theory proves to be correct as the result of careful tests in practical operation. Governors are now made of various types, embodying this principle, and have been found to compel the same number of revolutions per minute of the engine under any condition of load or boiler pressure, within the full capacity of the engine.

The remaining time of the session was given to the discussion of the following topics: "Are roller bushings expedient in journals at low velocities and under high pressures?" "What is the best material for lining brake-straps on elevators, cranes, etc.?" "What is the best way to secure tight fit of set screws tapped into heavy parts of a machine?" "How much should be removed from the edges of punched or sheared steel plate to cut away the injured metal?" "Have you used power moulding machines successfully in the foundry?" "What makes the best moulds for complicated steel castings, to secure solidity and freedom from shrinkage cracks?" "What is the effect of adding small per centage of wrought-iron or steel scrap in the foundry cupola or ladle.

A New Route for Export Traffic.

According to the New York *Times*, Mr. STICKNEY, President of the Chicago, St. Paul & Kansas City Railroad system, and a syndicate of English capitalists have devised and put well on its way towards execution a vast scheme for handling American export traffic in competition with the existing routes. A brief outline of the enterprise is as follows: The Furness Railway Company, of England, has recently invested large sums in the improvement of the harbor of Barrow, its northern terminus. Docks have been built with 274 acres of water in the slips and 400 acres of quay space, with a depth of water of 21 to 31 ft.; also a large dry dock capable of raising a vessel of 3,500 tons in 60 minutes, and also landing wharves slaughter houses, cattle pens and refrigerators.

Having made arrangements for handling a vast traffic at this point, members of the syndicate came to America and concluded arrangements with President STICKNEY and President EMMONS of the Staten Island Rapid Transit road for the American portion of the enterprise. The Minnesota & Northwestern—or Chicago, St. Paul & Kansas City which is to be the new name of the system—is to be extended to tap all the principal centers of the Northwest. On Staten Island large tracts of real estate have been secured, and a water front sufficient for building ample docks. The bridge across the Arthur Kill is being pushed rapidly along by the Keystone bridge company, and next season is to see the work in rapid progress on the terminals on Staten Island.

The report insinuates that the Baltimore & Ohio is to be the "missing link" between Chicago and the Arthur Kill and quietly ignores the fact that the B.& O. is not likely to come nearer the Arthur Kill than Philadelphia for some time yet. Possibly the Pennsylvania may have an interest in the enterprise which they have not yet thought best to make public. This much is certainly true of the scheme, that if cheap and convenient terminal facilities are built on Staten Island, the proposed line can compete very effectively for export trade by saving the expensive terminal charges at New York. Whether it can by this means secure a very large share of a traffic which is being fought for in many different directions by lines whose only hope of financial success lies in securing a lion's share of it, is a matter which time alone will show.

AN Austrian engineer has invented a scheme for the prevention of collision accidents on railways for which the Vienna papers claim a "great future." It is a safety carriage operated by electricity and preceding the train proper at a distance not stated. The electricity is generated on the main engine and the pilot is controlled by the engine driver. If the pilot meets an obstacle, certain glass tubes filled with mercury are shattered, an electric current is interrupted and a danger signal sent to the engineer in the rear, who is expected to at once put down brakes and stop his train. The inventor asserts that two express trains so equipped could run towards each other at full speed on a single track, and yet be stopped in time to prevent serious accident. Perhaps so; but we should prefer to be elsewhere than on either train.

ENGINEERING NEWS.

Gen. NEWTON, in his last quarterly report as Commissioner of Public Works of New York, remarks in connection with street paving in this city that the demand for skilled labor (pavers and rammers) has been so great that contractors have had to increase the pay from $3.50 to $5.00 and, in some cases, $6.00 per day. The result has been only one-third of the amount of work done as compared with preceding years.

THE grade crossing question is being actively agitated all over the country. At Springfield, Worcester, Boston, various points in Connecticut, Rochester, Jersey City and one or two other large towns besides Buffalo it is a very live question indeed. It is only lately that there has been much talk about it anywhere. It is a sign of our advancing civilization, and is destined to increase. No highway crossing of any kind should be permitted any longer, except in the thinnest settled districts, which is not either under or over or protected by gates and flagmen or by automatic alarm signals.

THE International Convention and Exhibition of 1888, at Brussels, promises to be an event of great importance and interest. The especial attention of the public is called to competitive exhibitions of the utensils and processes of mechanical industries, steam engines and special motors, and railway material and mechanical traction. The Exhibition seems well worthy of the attention of American manufacturers and full particulars can be obtained on application to ARMSTRONG, KNAUER & Co. 822-824 Broadway, New York.

THE Rapid Transit Cable Co., has been incorporated in this city by ROBERT I. SLOANE, H. H. MCALLISTER, ANDREW BRYSON, Jr., of the firm of Shunk & Bryson, No. 1 Broadway, and others for the purpose of introducing an improved cable motor and curve devices for use with heavy rolling stock at high speeds.

THE Sydney, New South Wales, *Morning Herald*, of Nov. 26, says that "four out of the six cylinders of the Hawkesbury bridge are down;" by which we understand that four of the iron pier caissons are down to their full depth and two pier foundations are yet to be sunk. The same paper gives a long account of a strike among the workmen, of ANDERSON & BARR principally, against the 10-hour system of labor introduced by them and the other American contracting firm of RYLAND & MORSE, which has in hand the erection of the superstructure. The trouble is that 8 hours are recognized as a day's work by the Sydney Government which is building the railroad connecting with the bridge; and while the American contractors pay more per day than the native contractors, the laborers object to the introduction of the system. The Americans insist upon doing the work in their own way and will probably win.

LATER advices, from the Union Bridge Co., say that the strike is over. And that in addition to the four pier foundations now completed, Pier-caisson No. 5, is half-way down, and Pier-caisson No. 6, has been towed into position and is sunk upon the bed of the river with excavation now in progress. Messrs. RYLAND & MORSE will very shortly begin upon the erection of the superstructure.

Sir FREDERICK ABEL, in a paper read before the Institution of Civil Engineers on "Accidents in Mines," says that fire-damp explosions are not the most fertile cause of loss of life in mines. In the reports of the Royal Inspectors of Mines for 1875-1885, it will be seen that out of 12,315 deaths only 23.57 per cent. occurred from explosions of gas, while 40.77 per cent. were chargeable to falls of roof and sides of mine workings, and the other 35.66 per cent. were the result of miscellaneous accidents.

THE New York Central and Hudson River Railroad company has adopted Westinghouse's new automatic air brake for passenger and freight trains. Thirty trains have already been equipped with the new brakes.

The Effect of Temperature upon Structural Iron and Steel.

(*Continued from page 400.*)

DISCUSSION.

Mr. HUNT: I shall agree with Mr. RAMSEY in what he has stated. To the question, "Should a temperature be prescribed in specifications at which the nicked bending test for texture shall be made, or at which the iron should show good fibrous iron?" I should answer, yes. We all know that this is not a common demand in specifications for material. All specifications demand that the iron shall be fibrous, but they do not say at what temperature it shall be tested to prove it.

My own experience, as Mr. RAMSEY has stated, has been very considerable in just this same line, and it has been almost uniformly to the same effect, that with the same iron the character of the fracture will be almost totally different, according as the temperature is high or low at which the tests are made. This has been the case when the character of the tests were uniform, or as nearly uniform as we can make them.

As Mr. RAMSEY has described, even in our experiments, when we had the bars made especially for the work, of best quality bridge iron, after they were cut off and nicked in the planer so that there would be no effect from the cuts of a tool, placing them exactly the same distance apart, center to center, and dropping the ball the same height, and letting it drop under the same circumstances, except that the element of temperature was different, we got the varying results shown.

One gentlemen, Mr. METCALF, to whom I showed the results in the photograph and some of the fractures, whose ideas had been very much as those of the other engineers whom Mr. RAMSEY quotes, that it could not be possible to show that the difference in the fractures was due only to the difference in the temperature, said to me, "I will believe this if you will make one other experiment; if you will take some more of that same bar iron, 4½ in. wide, cut it right in two, parallel to its longest axis, take the two strips, the one beside the other on each side of the bar, nick them, and then test these two strips, the one under a high, the other under a low temperature, the same as described in these experiments, and you find the same state of affairs." The result of these tests were the same; the bars tested under low temperatures gave uniformly the more crystalline fracture and broke with less blows of the drop ball.

We have made many tests, and the illustrations that we have here are only samples of many that have been obtained; many of them in a practical way and many of them just in an experimental way, as we have described; but in all these experiments we have tried, just so far as possible, to have all other circumstances other than the element of temperature exactly the same.

I have heard some of our brethren of the steel persuasion saying of the analyses, that 0.21 per cent. of phosphorus would be pretty high for steel; but, of course, we must recognize the fact that it is wrought iron referred to here, and that 0.21 per cent. phosphorus in iron is not a high percentage, it indeed, is the ordinary percentage in good bar iron. I do know, from my own experience, that whatever the qualities of iron which under these circumstances show varying crystalline development, the better the quality of the iron the tougher and more ductile it shows under ordinary circumstances, the less the crystalline character is developed by the difference of temperature; but at the same time, with the very best quality of bar iron we can obtain, as samples here have shown, the same general effect is observed. We find almost always that the tensile results are a little higher in ultimate strength and elastic limit, but that the fractures vary very little, comparatively, the reason being that the work heats up the metal so that we do not get the influence of the temperature alone.

Mr. BECKER: I think I was, perhaps, the first one who was favored by Mr. RAMSEY with a communication on this subject. A short time after he made his first tests in Cincinnati he sent me a message stating the results briefly, and asking me whether I thought that iron which behaved as this had done under the tests, was fit to go into a bridge. Well, I must confess that the figures startled me, and I thought there must be some mistake. I think I asked for a repetition of the message, and after reading it a second time I told him that I could not possibly think that the small variation in temperature should have had such an effect upon the iron under test as he stated in his message, and asked him whether he was quite certain that the different tests were made of the same kind of material.

Then he wrote me at greater length, stating substantially and in greater detail the results. They have certainly surprised me, and have led me to make a request of Mr. BUCHANAN, who, I am sorry to say, is not here to-night, to make some tests for our own benefit in further pursuit of this subject, and while I have no full report from him, I have been informed that he has made some additional experiments, and, as near as I can now recollect, they do not prove the facts quite to

the extent they were stated in this paper. In other words, he stated that after making the chemical test, in the first place, with the various pieces (although the number of experiments was rather limited and it is, perhaps, hardly admissible to reduce their results to a fixed law, but it shows the tendency), that whenever the impurities are eliminated to such an extent out of iron as to make it suitable for bridge purposes at all, then the striking variation that is shown in these tests to a large extent disappears, just about as Mr. HUNT has stated. I am very sorry that Mr. BUCHANAN is not here, for I know that he had prepared himself to take active part in this discussion; but while I think he is loaded, I do not think the results of the explosion will be very dangerous.

I will further say, in regard to the first question which is asked here, as to whether the specifications should require that temperature tests should be made, particularly bending and nicking tests: I know that Mr. MORISON, a bridge builder and engineer of large experience, who has built a great many extensive structures in this country, insists upon tests being made at low temperature of the materials that he places in the structures. I also think that Mr. VAUGHAN, of the Louisville Bridge Co., had at one time insisted on the same thing, though whether it was embodied in his specifications or not I do not know, but the practice is, to a certain extent, rational enough. This illustration is striking just to the extent as you may make any extreme case apply to one that has a more limited range. Still it shows the general tendency of the case. I have not had time to look into any further authorities on the subject myself. I largely relied upon the information to be furnished by Mr. BUCHANAN'S experiments on the subject, but I think it is sufficiently interesting to warrant a continuance of the consideration of this paper. It is a matter of the greatest importance to the profession and to the community at large.

There is one more thing that I would like to say a word about, and that is the question of breakage of steel rails during the winter. In the first place, I must say that Mr. RAMSEY'S assertion that our bridges break more frequently in winter than in summer is hardly borne out by the facts. The season has not had anything to do with it so far as actual occurrences are concerned.

When it comes to iron, the startling thing in this paper is the change of texture in the structure of the metal, from a fibrous to a crystalline state, which, when developed under different conditions of temperature, would indicate, judging from the results of Mr. RAMSEY'S tests, a deterioration of the metal, at least as far as its resisting capacity against impact is concerned. Now, that change cannot occur to that extent in steel rails. I do not think that anybody has ever seen the structure of steel rails change under such slight variations in temperature to any perceptible degree. It is barely possible that steel becomes a little more compact under a reduction of heat, but it does not undergo any such change as iron when it passes from the fibrous to the crystalline structure.

If this is the troublesome part in iron, it cannot account for the rupture and breakages of steel rails in the track. If the temperature affects the iron and reduces its strength because it changes from one structure to another, that does not seem applicable to me in steel, and I may say that in our own experience the statements made here are not borne out. We find that the steel rail breakages are more largely due to mechanical defects, and they generally develop themselves immediately or very soon after they are placed in the track. In other words, if there are any defects they will very soon manifest themselves, and if, as is claimed, there are more breakages in winter than in summer, it is probably due to the fact that the deliveries of the rail are usually delayed until late in the season, and are then crowded in during the winter, when the defects will develop themselves soon afterwards. But aside from the hard inelastic condition of the roadbed during the cold season, which certainly does have an indirect effect upon the rail, I do not believe that the temperature alone has any direct effect upon the strength of steel rails free from mechanical defects.

I am well aware of the prevailing impression that failures of rails in railroad tracks are of more frequent occurrence during winter than during summer, and that the low temperature is the cause; but I have come to look upon this impression as one of those popular superstitions, which are neither borne out by the facts, nor susceptible of positive proof. If the temperature is the cause of the more frequent failure of rails, it certainly is not the *direct* cause, and cannot have more than an indirect influence in the matter. I am sure that a great many failures of rails are charged to cold weather when their true cause should be attributed to entirely different circumstances. A single broken wheel under a freight car on one of our western divisions nicked and chafed the rails on four miles of track in such a manner that they broke by the hundred soon afterwards. The blows given by trackmen in their efforts to straighten steel rails, or bend them to conform to the curves, have caused thousands of fractures, many of which were probably attributed to the cold weather before the true character of steel rails was fully understood.

[We are satisfied Mr. BECKER is in error in these conclusions as stated on the editorial page.—ED.]

Mr. RAMSEY: In regard to steel rails, Mr. BECKER, I agree with you that generally a flaw in steel rails will appear immediately after it is laid, if at all; but how do you find the breakages of rails that have been laid a year or more? Do they occur oftenest in the summer or winter? In the lot I referred to I do not suppose there were more than two or three laid in the preceding year; most had been down ten or twelve years. Of course it was old steel. In the warm weather we have hardly one breakage reported. Of course, if the fault is in the steel, then the flaw will show itself almost immediately after it is laid, but after being down ten or twelve years I think there must be some other reason for it.

Mr. RAMSEY (in answer to a question as to what replies he obtained from the engineers to whom he had written): Mr. BUCHANAN wrote that his practice was to make all tests regardless of the temperature. Mr. BOLLER, Mr. CHANUTE and Mr. COOPER, indeed all of the engineers, Mr. BECKER, included, I believe, stated that they made no temperature tests whatever, but Mr. BECKER wrote me that he had known or heard of some engineer that did make temperature tests, but Mr. VAUGHAN is the only one I have heard of.

I agree with Mr. BUCHANAN that if we get a good iron, and an iron that is fit and proper and all that we ought to have, we might have an iron that would not be affected by the changes in temperature we meet with in this climate. In regard to the question of phosphorus or impurities, I stated in the paper that whether it was due to too much phosphorus, or anything else, that it seemed to me, that the fact that a piece of iron when broken at one temperature shows a certain fracture, and the same piece, with, of course, the same amount of phosphorus, broken at another temperature, shews a different fracture, or character of fracture, with a different number of blows required to break it, would go to show that the temperature must have something to do with it. The temperature will not increase the degree or amount of impurities in the iron.

Mr. DEMPSTER: Would that raise an element of importance in this matter—the amount of phosphorus to be put into the material?

Mr. RAMSEY: No, not at all. When we take bridge iron that would be accepted by any of the inspectors and made by such reputable firms as Carnegie Bros. & Co. Limited, as their best bridge iron (no scrap iron in it), and the tests made in the shop (most of them in the presence of Mr. BUCHANAN) show that it is good iron, iron which any one would accept, and then it produces this fracture, it strikes me it must be due to something besides the quality of the iron.

But the object of the paper is attained, when we get Mr. BECKER and others to investigate the matter. I wrote to Mr. BECKER, or rather telegraphed him, because I had the utmost confidence in his opinion, and would have yet if he would say that his tests show that temperature does not affect the strength of iron.

TO BE CONTINUED.

CONSTRUCTION NEWS.

Water.

The Bound Brook Water Co., of Bound Brook, N. J., has been incorporated at Trenton, with a capital stock of $40,000. The company will construct the dam and reservoir in the vicinity of Buttermilk Falls, and from the dam to the corner of Main and Hamilton streets there will be a fall of about 100 ft. President, JAMES M. THOMPSON, of Bound Brook; Manager, SYLVANUS AYERS, Jr., of Lambertville; Secretary and Treasurer, W. B. R. MASON.

Water-Works.—*Maine.*—Presque Isle. The pumping station is completed, and the pump to be used for fire purposes is ready for use.—Boothbay. The village of Boothbay Harbor has voted to pay $250 per year for 25 years, in addition to the $1,200 per year voted by the town last June, to secure a water supply for 20 fire hydrants, 2 drinking fountains and 4 schoolhouses free. A. R. NICKERSON, D. L. MOODY and THOMAS BOYD have been appointed a committee to negotiate the contract. It is expected that a supply will be obtained by next season.—Belfast. The water-works have been completed, tested and accepted. They were built by Wheeler & Parks, of Boston.—Eastport, Me. Water-works are being put in.

Vermont.—Swanton. The works are nearly completed, but have not yet been formally accepted. The contractors are Lang, Goodhue & Co., of Burlington, Vt.

New Hampshire.—Dover. A vote held Nov. 30 on the adoption of the act passed recently by the Legislature authorizing the purchase of three aqueduct companies and the construction of new water-works, resulted in 1,335 for and 346 against. The construction of the new works will be commenced in the spring.

Massachusetts.—Fairhaven. A citizens' committee has been organized to consider the question of establishing a water supply. A domestic supply will be obtained from a well, with a fire supply from the mill pond. The cost is estimated at $50,000; the works to be built by a local company, and the town to pay an annual hydrant rental and grant an exclusive franchise for water-works and electric light. JOSEPH K. NYE is interested.

Connecticut.—Windsor Locks. The Windsor Locks Water Co. has appointed ED. D. COGGAN and HENRY C. DOUGLASS a committee to investigate plans presented and make estimates of the cost of piping a supply from Kettle brook to the town.

Pennsylvania.—Reading. The water in the reservoirs is still going down. The water board will take steps to obtain a temporary additional supply, and ultimately a permanent supply.—Lebanon. An additional supply is needed before next summer, and the city proposes to purchase the dams of a defunct canal company and utilize their storage capacity for city purposes.—Lancaster. Work is progressing for the new water-works.

Ohio.—Circleville. After a satisfactory test the City Council accepted the new water-works on Dec. 1.—Cincinnati. The question of appointing 4 experts to devise means for furnishing an ample supply of good water has been indefinitely postponed.

West Virginia.—Guyandotte. A water supply will be furnished from Huntington by the Huntington Water Co.

North Carolina.—Fayetteville. The city has accepted the proposition made by F. C. DERICHARDS to build water-works.—Henderson. The city is corresponding with parties who propose to build water and gas works. Address the Mayor.—Asheville. The water-works are completed. The supply is pumped by water power from the Swannanoa river at a point 4 miles east of the city, through a 12 in. pipe to a standpipe. The cost is about $100,000, for which amount the city issued bonds.—Oxford. A company proposes to build water-works, gas-work and an electric light plant. Address the Mayor.

Alabama.—Gadsen. The Gadsen Water Co. will put in a filtering apparatus.—Eufaula. The 3 artesian wells put down by the water company having failed to furnish a sufficient amount, a water supply will be drawn from the Chewalla creek or Chattahooche river.

Florida.—DeLeon Springs. A system of water-works will be put in by E. F. BARNEY.

Louisiana.—Baton Rouge. Smedley & Wood, of Dubuque, Ia., will commence the construction of the water-works in January. The system will comprise 2 pumping engines with a capacity of 1,000,000 galls. each; 6 miles of pipe, 75 hydrants and a steel standpipe.

Missouri.—Fulton. A vote on the issue of $8,000 for an artesian well and water supply resulted in 469 for and 398 against.—Alton. Water-works are contemplated.

Michigan.—Ithaca. A system of water supply is being contemplated.

Illinois.—Centralia. Mr. GEO. C. MORGAN, of Chicago, has presented an approximate estimate of $55,000 for the proposed water-works, and advised the city to build its own works. A supply from Crooked creek is recommended.—Paxton. Work is in progress on the new tank; the tank is 20 ft. high and stands on a tower 80 ft. high.

Minnesota.—St. Cloud. The St. Cloud Water Works Co. has been incorporated with a capital stock of $150,000. President, H. W. PHELPS; Treasurer, E. T. SYKES; Secretary, G. M. VANVALKENBURG, all of Minneapolis.—Mankato. The new reservoir of 1,000,000 galls. capacity is nearly completed; it is 200 ft. above the city and is supplied from wells. A 16-in. main connects with the pipe system.—Minneapolis. An additional water supply is advocated: the two old Holly pumps will be established at North Minneapolis and give a supplementary supply of 2,000,000 galls. per day.

Wisconsin.—Janesville. The new water-works will be completed next season.

Montana.—Butte.—The new water supply of the Silver Bow Water Co. has been condemned as unwholesome; being contaminated by sewage and the seepage from the graveyard.

California.—Anderson. The water company is laying mains and building a reservoir. The supply will be drawn from Igo creek.

Texas.—Taylor. Water has been pumped from the San Gabriel river to the reservoir through the new main.—Temple. A water supply from the Leon river will be established by Major BURKETT, of Houston. He will utilize the present plant. The city will take 25 hydrants and pay $2,000 for the first year, and $2,500 per year afterwards.

New Mexico.—Raton. The artesian well has struck a plentiful flowing supply of water at a depth of 1,750 ft.

Nova Scotia.—Kentville. The water-works are being put in by CRAFT & FORBES, of Boston. Pipe is imported from Scotland, free of duty, at $28 per ton.

Collapse of a Water Tower.—The water-tower at Thomasville, Ga., collapsed Dec. 6, killing 4 men and seriously injuring 4 more. The proposals for construction were mentioned in ENGINEERING NEWS, June 25, 1887, p. 419. The work called for was a brick tower 70 ft. above ground, 25 ft. diameter; wrought-iron tank 30 ft. high and 25 ft. diameter. Four other men clung to a portion of the wall which did not fall and were rescued by means of ropes and ladders. The water-works are in course of construction. Population, 2,555.

Newton, Mass.—The Water Board has issued its report to the Council for the year 1886. During the year 22,164 ft. of main were laid: 1,187 ft. of 12-in., 4,213 ft. of 8-in., 13,938 ft. of 6 in. and 2,826 ft. of 2-in. Five supply pipes were laid and 298 service pipes. Meters must be provided for all service pipes to other than domestic faucets; 75 meters were added, and 1000 Crown meters ordered to be delivered by March, 1887, 525 of which had been set. The city contracted with the Manhattan Artesian Well Co., of New York, for an additional supply not exceeding 1,500,000 galls. per day from driven wells, in addition to the contract of 1885 for about 300,000 galls. per day. The works are in good condition. The total amount pumped was 247,966,122 galls., about 25,000,000 galls. more than in 1885. Tables are given of the extensions, consumption, etc., also a financial statement, and a diagram of the rainfall and consumption since 1887. The report of the City Engineer, Mr. ALBERT F. NOYES, on the additional supply, is appended, together with a report of tests made on cast-iron pipe. The report contains a plan of the pumping station and vicinity, location of the wells, and illustrations of the pipe tests. EDWARD W. CATE, is President of the Water Board; ALBERT F. NOYES, Engineer, and H. NELSON HYDE, JR., Superintendent.

Weights of Cast Iron Water Pipe.—The following is a table of weights, dimensions, etc., of straight water pipe used at Newton, Mass.:

Nominal Diameter.	Class.	Head to which pipe is adapted	Length over all.	Thickness.	Standard Weight.
Ins.		Ft.	Ft. Ins.	Ins.	lbs.
24	c	224	12-4½	1 1-32	3,227
20	B	177	12-4½	27-32	2,208
20	b	138	12-4½	25-32	2,058
16	B	204	12-4½	25-32	1,645
12	c	216	12-0	11-16	1,070
12	B	151	12-0	5-8	982
8	c	240	12-0	19-32	623
8	b	142	12-0	17-32	564
6	B	242	12-0	17-32	428
4	B	312	12-0	1-2	280

Tests of the pipe were made at the U. S. Arsenal, Watertown, N. Y., in July, 1886, and resulted satisfactorily. The report and table of the tests, with sketches of the burst pipes, are given in the report of the Water Commissioners of Newton, for 1886.

Proposals Open.

Dredging and Embankment.—At Jones's creek, near Hampton, Va. WM. C. GUSNELL, C. E., Headquarters of Southern Branch of National Home for D. V. Soldiers, Hampton, Va. Dec. 12.

Water-Works.—Plans and specifications prepared, THE WATER TRUSTEES, Hammond, Ind. Dec. 12.

Passenger Station.—At Logansport, Ind. L. F. LOREE, Engineer Maintenance of Way, Chicago, St. Louis & Pittsburg R. R. (office of J. R. Trimmer, Trainmaster), Halsted street freight station, Chicago, Ill. Dec. 13.

Paving.—Asphalt blocks, sheet asphalt, organite graywacke blocks or wood blocks; blue stone or granite curb. JOHN B. HOWARD, City Surveyor, Savannah, Ga. Dec. 14.

Brick Sidewalk.—Twenty blocks of brick sidewalk, stone curb, street crossings, etc. FRED J. H. RICKON, City Engineer, Little Rock, Ark. Dec. 14.

Paving.—ANDREW RINKER, City Engineer, Minneapolis, Minn. Dec. 15.

Post Office.—At St. Jerome, Que. Plans and specifications at the Department of Public Works, Ottawa, and at the office of J. H. LECLAIR, Surveyor, Mayor of St. Jerome. A. GOBEIL, Secretary, Department of Public Works, Ottawa, Canada. Dec. 15.

Machinery for Swing Bridges.—For operating bridges over the Chicago river at Madison and Randolph streets. Separate bids. GEO. B. SWIFT, Commissioner of Public Works, Chicago, Ill. Dec. 15.

Grading, Filling, Retaining Walls, Etc.—Grading, rock and earth excavation, filling in, retaining walls, culverts, etc. THE COMMISSIONERS FOR THE IMPROVEMENT OF THE STATE CAMP GROUNDS AT PEEKSKILL, State Arsenal, 35th street and 7th avenue, New York City. Dec. 16.

Sewer.—Vitrified, 12-in. stoneware pipe drain. Y-branches and lamp-holes. THOS. J. LANAHAN, Clerk Board of Contract and Apportionment, Albany, N. Y. Dec. 19.

Water-Works.—The following are the proposals received for the construction of the water-works at Findlay, O.:

	Huston & Freeman, Cincinnati.	H. H. Campfield, Findlay, O.	Jas. Swisher, Urbana, O	F. Scanland & Co. Erie, Pa.	Wm. Norris, Findlay, O	Geo. Weischel, Findlay, O
Reservoir	$56,709.36	$83,331.05	$88,984.75	$98,023.72	——	——
River Improvement	12,612.87	37,478.67	18,728.47	——	——	——
Masonry Dam	9,348.06	9,331.22	——	——	——	——
Filter Embankment	11,876.38	10,669.94	22,236.23	——	——	——
Gate Chamber and Bridge Pier	969.86	1,003.61	——	——	——	——
Foot Bridge	156.97	275.00	——	——	——	——
Pump Wells, Pumping Station and Building, Foundations	16,347.56	16 179.92	——	——	——	——
Suction Conduit (laying)	572.00	1,656 00	——	——	——	——
Improvement to Pumping-Station Grounds	296 21	299 53	——	——	——	——
Storm Water Drain	6,907.50	7,737.75	7,845.00	——	$4,362.00	$5,166.70

The contract was awarded to Huston & Freeman; total price, $115,766.77. The Chief Engineer is JOHN W. BILL Glenn Building, Cincinnati, O.

Dock Work and Dredging.—New wooden pier and appurtenances at E. 117th street, Harlem river; new crib bulkhead and dredging at same place. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. Dec. 19.

Bridge.—Rebuilding and keeping in repair for 7 years the Fort Argyle bridge, over the Savannah & Ogeechee canal, 14 miles from the city. Plans and specifications at the office of the County Engineer, City Exchange Building. THE COMMISSIONERS OF CHATHAM COUNTY, Savannah, Ga. Dec. 22.

Municipal Buildings.—For Toronto. E. J. LENNOX, Architect. JOHN JONES, Chairman Court House Committee, City Hall, Toronto, Canada. January 3, 1888.

Harbor Work.—For the improvement of the harbor of Pernambuco. J. AUGUSTO P. DA COSTA, Charge d' Affairs of Brazil at the Brazilian Legation, Washington, D. C., or at the Brazilian Consulate General, New York. January 31, 1888.

Bridges, Canals Etc.

Docks.—A syndicate, in which E. FLYNN and E. A. FLYNN, of New York are interested, will build docks at Port Royal, S. C., and open railroad communication with Birmingham, Ala.

Ohio Canal.—The new lake outlet at Portsmouth, O., was opened last month.

The New Jersey & San Domingo City Bridge Co. has been incorporated in New Jersey to build an iron highway bridge across the Ozama river under a grant from the city of San Domingo, in the West Indies. President, NATHANIEL MCKAY; Secretary and Treasurer, W. H DAVEE.

New Bridges.—*Elizabeth, Pa.*—The Elizabeth Bridge Co. has been incorporated to build a bridge over the Monongahela river. President, W. W. O'NEIL, of Elizabeth; Vice-President, JOHN A. SNELL, of West Elizabeth; Secretary, P. T. B. SHAFFER. Capital stock, $25,000.

Wheeling, W. Va.—It is proposed to build a union bridge across the Ohio river, and an Eastern syndicate has submitted a proposition. The Board of County Commissioners, the City Council and the Chamber of Commerce have appointed committees.

Memphis, Tenn.—It is reported that the negotiations between the railroads and the syndicate holding the Ford charter for a bridge over the Mississippi, have fallen through, and the syndicate will now enter into arrangements with the Union Bridge Co.

Dubuque, Ia.—The new highway bridge has been completed and opened. There are 4 spans of 205 ft. and 1 of 248 ft.; iron superstructure on masonry piers. Work was commenced in Sept., 1885. The total length of bridge and approaches is 2,800 ft. The channel span is 55 ft. above high water. The contract was let to M. Horton, of Rochester, Minn., for $127,500.——The bridge of the Dunleith & Dubuque R. R. has been sold to the Illinois Central R. R.

Omaha, Neb.—A new railroad bridge is contemplated for the Chicago, Milwaukee & St. Paul R. R., and surveys are being made. The road will probably, however, obtain running powers over the Union Pacific bridge. ——The new bridge between Omaha and Council Bluffs has been opened. The bridge carries a railroad and highway, is 1,760 ft. long and has 10 spans, four of 250 ft., and three of 125 ft. The bridge was built by the Union Bridge Co. to the design of GEO. S. MORISON, Chief Engineer.

Galveston, Tex.—A bridge is proposed to be built to the mainland.

Laredo, Tex.—The Mexican National Ry. will replace its wooden structure with an iron bridge purchased from the International Ry. Co.

Selkirk, Man.—Surveys are being made for a bridge across the Red river.

Contracting.

Water Tank.—The contract for a water tank at Allegheny, Pa., has been let to Saylor, Briggs & Lyons, for $3,283.

Crib Bulkhead.—The following proposals for a new crib bulkhead and dredging at W. 153th street, were opened Dec. 1 by the Dock Commissioners, New York City: Duncan A. Gillies, $14,360; John W. Flaherty, $18,500; Joseph Walsh, $19,000; John W. Monks, $21,675. The contract was awarded to Duncan A. Gillies.

Artesian Wells Wanted.—Contractors for wells are advised to correspond with W. H. Murdock, of Dalton, Ga., who is reported as wanting a number of wells driven.

The Southern Railroad Construction & Improvement Co. has been incorporated at Chicago, Ill. by HORNER C. HARTMAN, W. R. CHURCH and W. H. CRUMPTON. Capital stock, $125,000.

Water Pipe.—The Board of Trustees of the Water-Works, Springfield, O., has recommended the laying of 5,310 ft. of additional water pipe, and has requested the City Council to authorize the Board to receive bids and to contract for material, trenching, pipe laying, etc.

Artesian Well.—The City Council of Princeton, Ill., has awarded the contract for the artesian well to J. P. Miller of Chicago.

Submarine Pipe Laying.—John F. Ward, of Jersey City, N. J., has contracted to lay about 6,000 ft. of cast-iron water pipe across the Guyas river at Guyaquil, Ecuador; contract price, $43,000.——Mr. Ward has also a contract to lay 1,250 ft. of 12-in. cast iron water pipe across Burrad inlet, British Columbia; contract price, $12,000.

Sodom Dam.—Proposals for the construction of the Sodom dam were received Dec. 7 by the Aqueduct Commissioners, New York City, from the following firms: John B. Quackenbush; A. C. Belden; H. Soule & C. H. Raynor; George E. Clark and Patrick O'Hara; Arnold & Stevens; Henry Collins; Paige, Cary & Co; O'Brien & Clark; Sullivan, Ryder & Dougherty; Ryan & McDonald; Nolan Brothers & Co.; Smith, Ripley & Brown; Miles Tierney; Jeremiah R. Byron; John Cox & Co.; Richard A. Malone; Andrew O'Rourke, who, apparently is the lowest bidder, and J. S. Brown. The totals have not yet been figured out.

The St. Johnland Contracts.—The Kings County Board of Supervisors, of Brooklyn, N. Y., has awarded the contracts for the improvements at St. Johnland to Edward Freel, at his bids as follows: Water supply, $149,303; sewers, $156,445; roads, $50,960; aggregate $356,708. The several bids and prices were given in ENGINEERING NEWS, p. 393, and a complete list of the detail prices of each bid is given in the printed report of the adjourned meeting of the Board, held on Nov. 15.

Water-Works Wanted at St. Andrew's, N. B.—Mr. T. MCGRATH, who is interested in the proposed water supply, is now in New York, and may be seen at 120 Broadway, seventh floor, room 36. The proposed source is a lake 4 miles distant, with a head of 80 ft., which is not sufficient for a fire pressure by gravity. If the cost of piping will be very great a supply may be obtained from wells, the soil being sandy. The town is small but there is a project in hand to increase its popularity as a summer resort, in which ERASTUS WIMAN, of New York, is interested, and for this purpose a water supply is essential. Pipe can be obtained cheaper from England than from this country; (at Kentville, N. S., pipe was imported from Scotland, free of duty, at $28 per ton). M. M. TIDD, C. E., of Boston, Mass., has visited the town recently to investigate the water supply matter. The proposed supply was described in ENGINEERING NEWS, Oct. 15, (p. 285).

Pumping Engines and Pipe.—The following were the proposals opened Nov. 17, by Mr. ANDREW RINKER, City Engineer, Minneapolis, Minn.: Proposals for furnishing two 15,000,000 gallon pumping engines with boilers and appurtenances:

Knowles Steam Pump Works, Boston, Mass.:—
No. 1—$170,000; duty guaranteed 105,000,000 ft. lbs.
No. 2—$165,000; duty guaranteed 125,000,000 ft. lbs.
No. 3—$115,000; duty guaranteed 75,000,000 ft. lbs.

Holly Manufacturing Co., Lockport, N. Y.:—
No. 1—$163,900.
No. 2—Building, pipe, pipe laying, engines, boilers, etc., complete, $336,816.

If the city desires to lay the pipe, then deduct from complete proposal $27,000.

Henry R. Worthington, New York City:—

No. 1—$105,000; duty guaranteed 105,000,000 ft. lbs.
No. 2—$115,000; duty guaranteed 115,000,000 ft. lbs.
No. 3—$120,000; duty guaranteed 105,000,000 ft. lbs.
No. 4—$129,000; duty guaranteed 115,000,000 ft. lbs.

Proposals for the proposed building of the North Minneapolis Pumping Station:

Henry R. Worthington, $53,750; Ring & Tobin, 52,066.40; Kehoe Bros. $43,738; Jno. Berg & J. P. McArdle, $53,432.

Proposals for furnishing 12,000 ft. of 36-in. cast-iron water pipe:

	Per ton.
Cincinnati & Newport Iron & Pipe Co., Newport, Ky.	$32.50
Shickle, Harrison & Howard, St. Louis, Mo	30.70
A. H. McNeal, Burlington, N. J.	30.69
R. D. Wood & Co., Philadelphia, Pa.	30.50
Lake Shore Foundry, Cleveland, O.	33.00
Dennis Long & Co., Louisville, Ky	28 40
H. R. Worthington, New York	31.10

All pipe to be delivered by Lake Shore Foundry at $33 per ton or one-half of the amount at $29.70.

The contract for the pumping engines, boilers and appurtenances was awarded to H. R. Worthington at $129,000; the contract for the water pipe was awarded to Dennis Long & Co., at $28.40 per ton; the contract for the pumping station was not awarded.

Steam Fire Engine.—The Fire Commissioners, Cincinnati, O., have awarded to the Ahrens Manufacturing Co., of Cincinnati, (the only bidder), for $4,200, the contract for one straight frame, double pump, steam fire engine of the second size (a duplicate of Engine No. 13), with patent equalizing platform springs, and patent forced circulation coil boiler, constructed of the very best quality of homogeneous steel, and to be of sufficient strength to bear twice the pressure ever required for fire service, to be covered with Russia iron jacket and surmounted with brass dome, and delivered for trial and acceptance within thirty days from date of award of contract.

Bridge Contracts.—*Bordentown, N. J.*—The Trenton Iron Works, Trenton, N. J., have the contract to build an iron bridge over Blacks creek, near Bordentown, N. J., for the Mercer County Freeholders.

Suffolk, Va.—Armstead & Joiner have the contract for several bridges near Suffolk for the Atlantic & Danville R. R. Co.

Macon, Ga.—The contract for the bridge across Tobesofkee creek, 8 miles from Macon, has been awarded to W. W. Heath.

Jacksonville, Fla.—The contract for a truss bridge and a roadway, aggregate length 430 ft., has been awarded by the Street Committee to the Jacksonville Building Association for $1,400.

St. Louis, Mo.—The contract for the iron and steel work of the superstructure of the Grand Avenue bridge has been awarded by the Board of Public Improvements to the King Iron Bridge & Manufacturing Co., of Cleveland, O., for $144 000.

Nelson, Neb.—The contract for the Bostwick bridge has been awarded to the King Iron Bridge & Manufacturing Co., of Cleveland, O., at $6,275.

Waco, Tex.—The following proposals for the construction of an iron bridge across the Brazos river, were opened Nov. 15 by County Judge WM. W. EVANS: King Iron Bridge & Manufacturing Co., Cleveland, O., $49 500; Missouri Valley Bridge & Iron Works, Leavenworth, Kan., $50,400; Decatur Iron Bridge & Construction Co., Decatur, Ala., $50,800; Penn Bridge Co., Beaver Falls, Pa., $52,500; Kansas City Bridge & Iron Co., Kansas City, Mo., $52,900; Columbia Bridge Co., Dayton, O., $53,475; Massillon Bridge Co., Massillon O., $54,600; Mt. Vernon Bridge Co., Mt. Vernon, O., $56,485; Smith Bridge Co., Toledo, O., $57,000; St. Louis Bridge & Iron Co., St. Louis, Mo., $59,000; Morse Bridge Co., Youngstown, O., $60,000. The contract was awarded to the King Iron Bridge & Manufacturing Co. The bridge will be 560 ft. long, with a roadway 20 ft. wide and two sidewalks 5 ft. wide. It will be carried on iron cylinder piers.

Sewers.—*Providence, R. I.*—The contracts for sewers on Hay street and West Park street have been awarded to Thomas Newman, of Brooklyn, N. Y., at $1 and $1.15 per ft. respectively for laying 12-in. pipe sewer; setting 6-in. connections, 10 cts. each; building manholes complete, $20 each. The materials to be furnished by the Board of Public Works.

Buffalo, N. Y.—The following proposals for building the extension of the Babcock street sewer have been received by City Engineer A. KRAUSE: W. A. Green, $45,359; D. W. McConnell, $52,080; Thomas Dark & Son $56,000.

Newark, N. J.—The following sewer contracts have been awarded to Thomas O'Conner: Hamilton and Liberty streets; 12 and 15-in. salt glazed sewer pipe, $1.25 and $1.70; manholes, $35; basins, $100. Spruce street; 12, 15 and 18-in. pipe, $1.20, $1.50 and $2; basins, $100; manholes, $30; flushing tank, $100. Twelfth avenue and South Seventh street; brick sewer 28 × 42-in., $4.65; 12-in. pipe, $1.20; basins, $100; manholes, $30; flushing tank, $100.

Cincinnati, O.—The following proposals have been received by the Board of Public Affairs: Sewers in Mt. Hope road and W. 6th street; H. Frank, 8 ft. brick sewer, $9.34 per ft.; 6-in. slants, 30 cts. each; catch basins, $78 each; round manholes, $28 each; sheeting, $18 per 1,000 ft. B. M.; total $3,856.80. R. S. Bearans, $11.85, 50 cts., $35; $39, $20, $4,847.50.—Rider Alley sewer; H. Nolte, 12-in. pipe, $1.85 per ft.; Y's on 12-in. pipe, 75 cts. each; oval manholes, $30 each; sheeting, $17; total, $906.10.

Anniston, Ala.—The Anniston Supply Co. has a contract for sewers amounting to $3,926.50.

Kansas City, Mo.—The City Council has affirmed the contract with John Ryan for the construction of the southwest district sewerage system, at $101,000. The great expense is due to the fact that portions of the main sewer will have to be laid in trenches 20 ft. deep in solid rock.

Highway Bridges.—The following proposals for the construction of two iron highway bridges were opened Nov. 22 by the Board of Commissioners, Defiance, O. W. T. HILL, County Auditor. The Clarksville bridge, across St. Joe river, to be of one span 165 ft. between masonry, roadway 18 ft. wide, height of truss not less than 26 ft.; capacity 80 lbs per sq. ft. of floor; two stone abutments. The Arrowsmith bridge, over Lost creek one span of 70 ft, between masonry, roadway 16 ft. wide; capacity, 80 lbs. per sq. ft.; two stone abutments.—*Superstructure.* Smith Bridge Co., Toledo, O.; Arrowsmith, $10.80 per lin. ft.; Clarksville, $21 or $25 per lin. ft. Variety Iron Works, Cleveland, O.: (A.) $10.25, (C) $21; Mt. Vernon Bridge Co., Mt. Vernon, O.; plan A, $11 plan B, $22. P. E. Lane, Chicago, Ill.; (A) $12.95, (C) $28.75. Massillon Bridge Co., Massillon, O.; specifications Nos. 1, 2, 3, $23, $21.75, $10.90. Pittsburg Bridge Co., Pittsburg, Pa.; plan B, $14.88 per lin. ft. or $1,116; plan A, $23.40 per lin. ft. or $4,095. Canton Bridge Co., Canton, O.; (A) $12.70 or $12.25; (C) $23. Lane Bros.; Newark, O.; (A) $13.64; (C) $26.33. Lomas Bridge Co., (A) $12, (C) $22.80. Morse Bridge Co., Youngstown, O.: (A) $15, (C) $29. Indiana Bridge Co., (A) $12.76, (C) $22.67; Penn Bridge Co., Beaver Falls, Pa.; (A) $13.20, (C) $23.70, Champion Bridge Co., Wilmington, O.; plans A, B, C, D; $10, $10.65, $11.50, $23.95 per lin. ft. Columbia Bridge Co., Dayton, O., (A) $15.24, (C) $26.88, or $8,553.60, and $23.49 or $8,164.80. King Iron Bridge & Manufacturing Co., Cleveland, O.; (A) $13.29, or $15.79 with iron joists; $12.39 or $14.90; (C) $22.17 or $24.75 with iron joists, $21.96 or $24.46, $18.54 or $21. St. Louis Bridge & Iron Co., St. Louis, Mo.: (A) $1,025, (C) $4,000: both together, $4,775.

Substructure: R. Ehrhart; (A) $7.90, (C) $8.80 or $9.30 per cu. yd. J. M. Weisenberger; (A) $8.25, (C) $10.50. John Snyder, (C) $10, $10.75 or $12.40. Iron Substructure Co., Columbus, O.; (A) $842, $929, $1,349; (C) $2,762, $3,889. Loeb & Son, (A) $8, (C) $10.75, $12.75. Bremer & McKoy, (C) $11.75 per cu. yd. T. S. Wight; (A) $9.85, (C) $10.48; both together, $10.15. The contract for iron work was awarded to the Smith Bridge Co., Toledo, O., at $21 per lin. ft. for the Clarksville and $10.80 per lin. ft. for the Arrowsmith bridge. The contract for masonry was awarded to R. Ehrhart at $9.30 and $7.90 per cu. yd.

RAILROADS

East of Chicago.

Existing Roads.

Pennsylvania.—The new line from Philadelphia to the ocean will be 52 miles in length. There will be 32 miles of new road to be built from Marlton, N. J., to Manahawken.—The new line through the town of Leechburg on the Western Pennsylvania division has just been completed and opened for traffic.

New York & New England.—The company has leased the Milford & Woonsocket road for 25 per cent. of the gross receipts.—The decree of foreclosure of the Connecticut Central road has been granted, and the road was turned over to the New York & New England on Dec. 8.

Grand Trunk.—The Beauharnois Junction road was completed to Beauharnois Dec. 2. JAS. WRIGHT, the contractor, celebrated the event by a supper to his men.

Central Vermont.—President SMITH is reported to have consoled himself for the loss of the Rutland road by purchasing the Sullivan road of the Connecticut River company.

Lake Shore, & Michigan Southern.—A report is in circulation that the company intends to complete the Chicago & Canada Southern road which was started many years ago as a parallel and competing line to the Lake Shore from Detroit to Chicago. The Vanderbilts acquired a controlling interest, and the road came to a sudden stop after 79 miles had been built. The Lake Shore proposes to complete the line to Chicago from its present terminus at Fayette, O., a distance of 190 miles and thus prevent any other company from utilizing this right of way for a competing line.

Cincinnati, Hamilton & Dayton.—Much to everyone's surprise the company has refused to defend the suit brought by bondholders of the Dayton, Fort Wayne & Chicago for the appointment of a receiver for the company and has filed a cross petition, requesting that the receiver be appointed and setting forth the various crooked practices with which the STAYNOR & IVES-Napoleonic combination engineered their little game of grab.

Chateaugay.—The tracklaying is completed on the extension of this Adirondack railroad to Saranac Lake.

New York, New Haven & Hartford.—The following is the financial statement of the company presented to the annual meeting:

The income of the road for the past year was $7,690,209, of which $4,319,252 came from passengers and $2,952,361 from freight. The total expenses amounted to $5,136,316. The total operating expenses were $3,526,619, including $4,000 for the rent of the Stamford & New Canaan road, $100,000 for the rent of the Shore Line road, and $148,110 for the rent of the Boston & New York Air Line road. For taxes $350,497 was paid, and for interest $250,000. The balance for the year was $1,753,892. The credit side of the balance sheet shows: Total expenses, $6,136,316; new construction, (four tracks) $672,581; sinking fund account, $80,500; dividends, $1,550,000; materials on hand, $463,795; balance cash, cash assets, $2,719,160; total, $11,622,355.

New Projects and Surveys.

Vincennes, Oakland City & Owensboro.—We are informed that the contract for making the preliminary survey on this Indiana line was let for $1,400. The distance was about 70 miles. The price, however, gives no information without a knowledge of the specification on which the bid was made. Of the general principle of selling engineering work at auction we have already said all that is needful.

Northern Maine.—The preliminary survey of this proposed road, from Presque Isle to Mattawamkeag is in progress. The survey from Houlton to Presque Isle will be made next spring.

Rochester & Glen Haven.—This company has been incorporated at Rochester, N. Y., to build a railroad 3¼ miles in length. The officers are F. S. MINGES, President; WM. S. FOSTER, Secretary; WM. C. GRAY, Chief Engineer, all of Rochester. Right of way has been already secured.

New Germantown.—A company has been formed at New Germantown, Perry county, Pa., to build a railroad to White House Station, J. R. FISHER of New Germantown is Treasurer and J. E. MELICK of Springfield, Ill., is Chief Engineer.

Rome & Carthage.—The projectors of this New York road are raising funds, and the company will file its articles of incorporation at an early date.

Columbia & Rensselaer.—A surveying party is at work on a line to run from Sandlake to Troy, N. Y.

Skowhegan & Norridgewock.—The Skowhegan, Me, board of trade are discussing the proposed line to Norridgewock.

THE NORTHWEST.

Existing Roads.

Duluth, South Shore & Atlantic.—Seventy miles of track have been laid from Nestoria, Mich., west, and track will be laid 14 miles farther this winter bringing the line within 76 miles of Duluth. Tracklaying is also in progress east and west from Dogwood, Mich.

Canadian Pacific.—The last rail is down on the extension to Sault Ste. Marie. Seven spans are erected of the bridge across the Sault.—The engineers who have been running a preliminary line to the Sault for the Grand Trunk, reached there on the same date that the Canadian Pacific line was completed.

Wisconsin Central.—President COLBY states that the company proposes to expend $1,000,000 or more in station buildings at Chicago.—The reported consolidation with the Northern Pacific is emphatically denied, but as the Standard Oil syndicate is heavily interested in both roads, it is quite evident that they will be apt to work in harmony.

Missouri Pacific.—On the extension from Superior, Neb., to Hastings, 15 miles of track are down and work is in progress. The officers of the company have offered to extend from Crete to Hastings if substantial aid is voted.

Illinois Central.—The headings have met on the Monticello tunnel on the Chicago, Madison & Northern extension. On the Freeport, Dodgeville & Northern extension, the tracklayers have reached Winslow, 11 miles from the junction with the above line and 19 miles from Freeport. On the Sioux Falls extension, the track is within 7 miles of Sioux Falls, but the bridge over the Big Sioux river will delay the completion of the line till Jan. 1.

Chicago, Milwaukee & St. Paul.—The 89 mile extension in the Wisconsin pine forests, from Merrill to Tomahawk Lake, has been completed and opened for business. Recent reports state that the line will be extended next season to L'Anse; but a preliminary survey has been made toward Union Bay, and it has also been proposed to extend it to the Gogebic mining region.—The company is said to be making surveys for a bridge across the Missouri river at Omaha; this, however, is stated to be a bluff game to obtain a crossing over the Union Pacific bridge. Nebraska people are ready to believe that the entrance to Omaha will be followed by a granger campaign in that State, and Denverites prophesy an extension to Denver. There seems to be some lack of executive vigor to bolster up the credit and reputation of the company since the death of Presi-

dent MITCHELL. The reports of earnings do not make a favorable showing; and unless active measures are taken by its owners, it is hardly likely that the company will be in a position for some time to approach the record for extensions which it made last year.

St. Louis, Alton & Terre Haute.

CREEL SPRINGS, Ill., Nov. 28.

EDITOR ENGINEERING NEWS:

The tracklaying on the first division of the Chicago, St. Louis & Paducah Railway, 15 miles in length, extending from Marion, Ill., to the crossing of the Cairo, Vincennes & Chicago Railroad one and a half miles southwest from New Burnside Station, is completed, and it is expected that trains will commence running through in a few days. This road is the southern extension of the Marion Division of the St. Louis, Alton & Terre Haute Railroad, commonly known as the Cairo Short Line, but is being built under a different organization. Twenty five miles more are under contract, including the heavy work on the Ozark Range, and of this some 10 miles of grading is substantially completed. About 14 miles remain to be located and put under contract which will be done early in January.

Yours truly,

E. W. MUENSCHER, Chief Engineer.

Chicago, Burlington & Northern.—A winter bridge 1900 ft. long, has been completed across the Mississippi river to Winona, Minn.——A party of engineers are making a survey from Winona westward *via* Rochester, Kasson, and Dodge Center, Minn.

Chicago, Santa Fe & California.—The last spike was driven on Dec. 7, completing the line from Ft. Madison, Ia., to Chicago. Regular trains are to commence running Dec. 19. The line through Missouri is being pushed and tracklaying will be finished in a few days.

New Projects and Surveys.

Minnesota Northern.—Incorporated at Worthington, Minn., by J. P. MOULTON and others. Capital stock, $5,000,000.

Springfield, Streator & Chicago.—Incorporated in Illinois by THOS. HAMER of Vermont, Ill., to build a road from Springfield to Streator Junction.

Cairo & Northwestern.—This Illinois company has elected C. O. PATIER, President, and HENRY WELLS, of Cairo, Cashier of the Alexander County National Bank, Secretary. A preliminary survey is to be made at once.

Choctaw Coal & Railway Company.—Incorporated at Minneapolis by GEO. B. KIRKBRIDE, JOHN WASHBURN, and others of that city, with a capital stock of $2,500,000.

Peoria & Michigan. Incorporated in Illinois to build a railroad from Peoria to the Wisconsin State line in McHenry County. E. H. WALDRON, L. M. KANE, A. S. OSGOOD and others of Chicago are the incorporators.

Lincoln Belt.—This company was incorporated March 4, and a survey was made. H. D. PERKY of Boston is at the Capital hotel in Lincoln, and has taken the contract to build the line, provided the present negotiations with property owners prove successful.

Duluth, Rainy Lake & Southwestern.—Amended articles of incorporation have been filed in Minnesota. NATHAN MYRICK of St. Paul is interested.

Winnipeg & North Pacific.

TORONTO, Nov. 25, 1887.

EDITOR ENGINEERING NEWS:

I send you a description of the land and route of the proposed line of railway from Winnipeg to Port Sympson, a distance of 1,630 miles. The charter compels us to build at least 50 miles each year, and we have two years from next April to commence work. The proposed route is as follows: From Winnipeg to the Narrows of Lake Manitoba, 100 miles. Here there are several large salt springs which could be utilized at once if this railroad were built. There will be quite a settlement along this hundred miles, and at the salt springs there is already quite a little village. This hundred miles can be completed and equipped for $15,000 per mile. From the Narrows of Lake Manitoba to Fort a La Corne is about 130 miles. Here there is a settlement of about 1,500 whites and half breeds; the land here is first class, and there are a number of groves of timber suitable for the work.

From Fort a La Corne to Fort Lac Labishe (population 2,500) is a distance of about 135 miles. Here we can get any quantity of oil by boring 100 to 150 ft. There is also an ample amount of timber, and excellent coal beds. From Fort Lac Labishe to Lesser Slave lake is 125 miles. Here is very productive land, plenty of coal and oil and a fair quantity of timber. From Lesser Slave lake to Fort Dunvegan is a distance of about 130 miles. Fort Dunvegan is on the banks of Peace river, a stream about 1¼ miles wide, and navigable for over 1,200 miles with an average depth of 10 ft. Quite a number of settlers are here; also quite a number of miners, earning from $5 to $10 per day by panning the sand, but provisions and clothing are so expensive that they barely make comfortable wages.

From Port Dunvegan to Port Sympson is a distance of about 1,010 miles through a fine country. Till within 250 miles of Port Sympson, where the land is rather rough, there are no engineering difficulties to contend with. This is called Peace River pass. Port Sympson is a natural port, fully protected from all winds. There is a settlement here of 3,000 people, and within 60 miles of this port is Queen Charlotte's island, containing large quantities of fine timber and coal. Miners are at work there now, and shipping coal to California.

When the 100 miles is completed to the salt district there will be no difficulty in getting the necessary funds to build and equip the whole line. The Government promises to give us a land grant of 6,400 acres per mile, the Canadian land bonds are selling in England at 106. Our land is far superior to the Canadian Pacific lands. On Peace river, wheat yields 40 bushels to the acre. The climate is far superior to that of Winnipeg. The tide of immigration is turned to this country and the land is increasing in value every year with a bound. The moment we commence building, the land along the line for agricultural purposes, will go up from $5.00 to $10.00 per acre. The whole line can be built and equipped in first class order for $20,000 per mile. One great point is that Port Sympson is *nearer* China and Hong Kong by 480 miles than Vancouver is. Yours respectfully,

A. P. MACDONALD.

Mr. MACDONALD, HENRY S. HOWLAND, ALEXANDER MANNING and others, are the incorporators of this company, and the former writes us that he desires capitalists to examine their scheme and go in with himself and his partners "upon the ground floor." That the proposed railway would open up a region to settlement of much agricultural value is doubtless true, and Mr. MACDONALD'S statement of the resources of the country is certainly worth careful examination.

THE SOUTHWEST.

Existing Roads.

San Antonio & Aransas Pass.—Surveys are in progress on the extension from Kerrville, Tex., northwest toward the Texas Panhandle.——On the Waco branch, track has been laid from Yoakum to Flatonia, 30 miles.——About 30 miles are graded on the extension from Skidmore to Collins.

Chicago, Rock Island & Pacific.—The party in charge of E. L. PRESTON, engaged on the location of the extension from Wellington, Kan., across Indian Territory, have worked nearly to the Texas line and expect to run *via* Wichita Falls.——Report states that instead of the Denver extension being built directly to Denver, it is to go to Colorado Springs, and that a trackage right has been secured over the Denver & Rio Grande from that point to Denver.——On the Herington & Salina line, the tracklayers reached Enterprise, 14 miles from Herington, Dec. 1.

Atchison, Topeka & Santa Fe.—Tracklaying is completed on the line from Atchison, Kan., to St. Joseph, Mo. The St. Joseph & St. Louis road, from St. Joseph to Lexington, will practically become a part of the Santa Fé system and be known as the St. Joseph, St. Louis & Santa Fé. It is shrewdly suspected that the Santa Fé survey from Carrollton to St. Joseph, which paralleled the St. Joseph & St. Louis road, was made simply for the purpose of bringing that company to terms.

Kansas City, Fort Scott & Gulf.—Extensive improvements are in progress between Kansas City and Rosedale, a distance of 4 miles, in the way of taking out curves, reducing grades and double tracking.——The Kansas City & Memphis has been chartered by General Manager NETTLETON and others to build a railroad from Marion, Ark., to the Mississippi river opposite Memphis, Tenn.

Cape Girardeau & Southwestern.—The party locating the western extension have reached Keeler, Butler county.

St. Louis, Arkansas & Texas.—A surveying corps is reported at work locating a line from Gatesville, Tex., towards San Saba.——The company has stated the terms for which it will build the proposed line from McGregor to Austin. The Austin & Northwestern, which it is rumored is backed by the Santa Fé, has also made an offer to the towns along the proposed route, and it is likely that one of the companies will build the line next season.

St. Louis & San Francisco.—A delegation from the Texas Panhandle recently visited St. Louis to induce the company to extend the line of the Atlantic & Pacific, which now terminates at Sapulpa, Ind. Ter., to Wheeler county in the Panhandle, to which point the line has been located.

New Projects and Surveys.

Kansas City, Lawrence & Nebraska.—Surveys have been completed from North Lawrence, Kan., to Grand Island, Neb., 274 miles; and from Mayday, Kan., *via* Palmer to Brantford, 33 miles.

Chicago, Kansas & Arkansas.—According to the St. Louis *Globe-Democrat* this company "has now made arrangements to build 3,000 miles of tracks. The main line will go to Galveston, Tex., one of its branches to Rich Hill, Mo., and thence to Memphis, Tenn., Grading all along the line will be commenced in a short time." It is also announced in a previous issue that the company has just been voted a $6,000 subsidy by the township of Washington, Kan. It is possible that it is on the financial backing of this sort of subsidies that the 3,000 miles of road are to be built! It is strange how people can be so easily gulled by schemes which are preposterous upon their face. It is true that many smaller projects are just as thoroughly wildcat, but they have at least the merit of possibility. At the same time the scheme is not quite large enough for everyone to notice its absurdity upon its face. Have the promoters ever thought what a grand idea it would be to keep right on from Galveston, bridge the Gulf of Mexico, and give St. Joseph a direct line to the fertile plains of South America! That would be something like.

Omaha & Mexican Air Line.—This company has been incorporated to build an "air line" railroad from Omaha, Neb., to El Paso, Tex., by W. F. CLEVELAND, Harland, Ia., C. C. FREE, Syracuse, Kan., and others. The comment upon the preceding enterprise is about equally applicable to this.

Mississippi Valley.—This is the title of a projected line from Bowie, Ark., to New Orleans along the west bank of the Mississippi river. HIRAM B. STEELE, of Natchez, Miss., is said to be interested in the scheme.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Arizona Narrow Gauge.—The name of this road has been changed to Tucson, Globe & Northern. A mortgage is to be executed to the American Trust Co of Boston for not more than $20,000 per mile. About 60 miles of the road are nearly completed, and work is to begin at once on the extension to Globe. From that point it is proposed to extend the line to a connection with the Atlantic & Pacific near the western boundary of New Mexico. W. C. CULVER is President and C. F. WALKER of Tucson is Chief Engineer.

Chicago, Rock Island & Pacific.—A large force are reported grading in northeastern New Mexico on the Pacific extension.

Chicago & Northwestern.—The Wyoming extension of the Fremont, Elkhorn & Missouri Valley road has been opened for business from Douglas west to Glen Rock, 29 miles. The total distance from Chicago to Glen Rock is 1076 miles.

Mexican National.—An iron bridge is to be erected across the Rio Grande at Laredo, Tex. It is also stated that a union depot will be built at Laredo. A survey is to be made at once for a line from Lampasas to Moriclova on the International road, a distance of about 40 miles.

Atchison, Topeka & Santa Fe.—A preliminary survey is in progress from Gallup, N. M., to Durango, Col., a distance of about 125 miles.——The branch to Canon City, Col., has been completed and will be opened for traffic Dec. 15.

Chicago, Burlington & Quincy.—Tracklaying on the Cheyenne & Burlington was completed to Cheyenne, Wyo., Dec. 1. The formal opening and celebration of the completion of the line will take place Dec. 13. The contractors for building the extension were Kilpatrick Bros. & Collins, of Beatrice, Neb.

Missouri Pacific.—The report that the Denver & Rio Grande and the Denver & Rio Grande Western are to form part of the Missouri Pacific system, has caused much talk in Colorado railroad circles. Actual consolidation is probably some distance in the future, but that the Missouri Pacific trains are likely to reach Salt Lake city over the Rio Grande's third rail is well known, and may indicate an eventual closer union.——The new union depot at Pueblo is to be 420 × 60 ft. and will cost about $200,000. S. T. SMITH of Denver, General Manager of the Rio Grande, is to let the contracts for its construction at once.

Southern Pacific.—The company seems to be concentrating all its forces just now on the San Joaquin & Tulare road, which is to parallel the main line from a point near Stockton to Lerdo or Posa. A considerable part of the line has been completed from Tracy south. Branches will cross from the new line to the old at Merced, Fresno, Visala & Tulare. Surveys are in progress for lines in southern California from Monrovia to San Dimas and Redlands, and for the Martinez and Livermore line in Contra Costa county.

New Projects and Surveys.

Pueblo & San Luis Valley.—This company has been organized at Pueblo, Col., to build a railroad over the route indicated by the above title. It is stated that the Santa Fé is back of the enterprise.

San Pedro, Los Angles & Utah.—Even the capacious maw of the California boomers seems hardly able to swallow this large scheme in its entirety. Messrs. ISAAC TRUMBO, H. R. HOUGHTON, and C. H. ROSER, the triumvirate who have been reported as making the preliminary surveys, have returned to San Francisco and report the road to be 664 miles in length. "The line," says the San Francisco *Call*, "will open up fine stretches of promising desert to which the Mohave is an oasis. At the very lowest estimate it will cost between twenty-five and thirty millions of dollars." However, since JAY GOULD is now definitely known to have a finger in the pie, even Nevada sage brush may be suddenly discovered to have "millions in it."

Deming, Sierra Madre & Pacific.—This company has purchased a large track of land near Lake Palomas, just across the boundary line in Mexico and will build a town there which will be their base of operations in constructing their proposed railroad. CHAS. H. DANA, of Deming, N. M., is interested.

Canadian & American Coast Line.—HERBERT C. JONES, of Toronto, Ont., has secured quite a notoriety by advocating a scheme under the above name. The proposed railroad would extend from Portland, W. T., to Juneau in southern Alaska, a distance of not more than 2,000 miles or so.